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Degradation and water quality dynamics of sugarcane residue in South Louisiana

Jose Roberto Deras
Louisiana State University and Agricultural and Mechanical College, jderas1@lsu.edu

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

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By

José Roberto Deras Cortez.
B.S. Universidad de El Salvador, 1989
M.S. New Mexico State University, 1998
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ABSTRACT

This research was conducted to assess methods to manage the residue blanket to avoid open field burning in sugarcane. Experiments were conducted in the state of Louisiana to evaluate methods to asses and potentially reduce water quality issues. Concentrations and frequencies of biological compost tea were sprayed on sugarcane combine-harvester residue blanket to increase degradation rate and reduce potential for runoff water to transport nutrients and sediments that may impair water bodies, while sustaining suitable sugarcane yield. Carbon dioxide evolution rate (mg CO_2-C) and CO_2 fluxes were measured in laboratory and in open field conditions; as an index to measure organic matter degradation. A runoff water novel collector was proposed to collect runoff water samples from sugarcane fields. Results demonstrate that carbon dioxide evolution rates (mg CO_2-C gr^{-1}DW h^{-1}) were increased when applying compost tea to a shredded and non-shredded material under laboratory conditions. However, no significant differences were found among treatments. The highest degradation rate was found when applying compost tea to a dosage of 5.6 m^3 $hectare^{-1}$ for a non-shredded material and 2.8 m^3 $hectare^{-1}$ for shredded material. Open field evaluations demonstrated that soil carbon dioxide fluxes (µmol m^2 s^{-1}) as an indication of organic matter degradation; were significantly increased when applying compost tea to sugarcane residue left in field. The most practical degradation rate may be achieved when applying a dosage of 2.8 m^3 $hectare^{-1}$ two times during the spring-time. The findings indicate that applications of biological compost tea and slow release nitrogen fertilizer could enhance nitrogen transport to water bodies. It may also indicate the opportunity to reduce supplemental inorganic nitrogen to sugarcane fields. Results partially support previous research indicating that combine-harvester leaves a residue blanket on soil, which may reduce sugar yields in subsequent crops; since sugarcane residue

management treatments were not significantly different (alpha = 0.05) with respect to yield during 2006 and 2007 harvest periods. Burning the residue also led to higher runoff water (175.2 m^3 ha^{-1}), high concentrations of suspended solids (93.4 mg L^{-1}) and up to 6.93 mg L^{-1} of PO_4 in runoff water.

CHAPTER 1
DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

1.1. Introduction

The term water quality is not a new concept; however, there is no way to define it precisely. The concept of water quality may have different meaning to an aquatic scientist concerned with aquatic life, a farmer concerned with irrigation, or a public health official concerned with the protection of human health. As a result, a different conception may be addressed from a different standpoint; however, water quality is generally related to the anticipated beneficial use of the water such as fish and wildlife protection, drinking water, or agriculture (Krenkel, 1980). Also, water should be managed so that no use at any other location will be detrimental to its use at another location. Any addition of something to the water which changes its natural state so that the in stream or downstream user does not obtain water that supports current or future needs may be considered as pollution.

Water pollution is one of the most critical natural resource problems in the world, and this condition will get worse as impacts increase. Groundwater is the source of drinking water to about 50% of the overall population in the United States, and over 90% of the rural population (Canter, 1996). The importance of groundwater in the overall water cycle that relates to the improvement are cultural, and economic activities cannot be neglected. Deteriorating and unacceptable water quality has the same impact on the economy as a water shortage. Indeed, a public concern must be addressed to maintain water supply under acceptable parameters, since minimal contamination has a devastating impact on groundwater, and surface water sources.

Water sources can be contaminated by several pollutants, i.e. chemical, physical, and biological pollutants. The sources of pollution can be classified as point and non-point source (Krenkel, 1980). Point sources release pollutants to water bodies at discrete and identifiable locations, i.e., industrial and municipal wastewater treatment plants, solid waste deposition sites or other fixed sources. Non-point sources are diffuse sources of pollutants that , may originate from natural process such as weathering of minerals, erosion of virgin lands and forest, or from artificial sources such as those related to man's activities, i.e., household products, fertilizer application, agricultural chemicals, erosion and transportation of soil material from agricultural areas. Agriculturally originated non-point sources are considered to be unintentional, because soil loss affects productivity over time.

Among agricultural practices nitrogen and phosphorus over-fertilization, and pesticide runoff are identified as major non-point source pollutants causing water quality impairment (LSU AgCenter, 2000). Nitrogen and phosphorus compounds present in fertilizers may be involved in the process of eutrophication of water bodies and the principal active agent present in pesticides and herbicides may be found in surface and deep waters or adsorbed to soil or sediments. The economics of commercially available nutrients implies that fertilizer application to agricultural lands is essential for a viable enterprise (Porcella and Bishop, 1975). Fertilizer inputs have been shown to achieve higher productivity, especially for cash-crops; substituting land, labor, and other inputs that are less economically attractive. Total fertilizer usage continues to increase.

Nitrogen can exist in many forms in the environment. The atmosphere is 79% nitrogen (Canter, 1996). The movement and transformation of these nitrogen compounds through the biosphere can be characterized by the nitrogen cycle (Figure 1.1). Nitrogen transformation can occur by several mechanisms: fixation, ammonification, synthesis, nitrification and denitrification. Fixation refers to the incorporation of gaseous nitrogen into a chemical organic compound available for plants and animals; ammonification is the change from organic nitrogen to the ammonium form (NH_4^+), in general this occurs during decomposition of animal and plant tissue; synthesis or assimilation, refers to biochemical mechanism that use ammonium or nitrate (NO_3^-) compounds to form plant protein and other nitrogen –containing compounds; nitrification is the biological oxidation of ammonium ions to nitrate, this is accomplished in soil by two specific bacteria: nitrosomas and nitrobacter; denitrification refers to the biological reduction of nitrate to nitrogen gas (N_2).

Firestone (1982) reported that approximately 23 genera of bacteria can perform denitrification and that almost all denitrifying bacteria are anaerobic organisms capable of anaerobic growth only in presence of nitrogen oxides.

Nitrogen along with carbon are elements essential for life. Supplementing grain and grass forage crops with organic and inorganic fertilizers has long been recognized as a key to improving crop yield and economics returns, especially for cash-crops (Follet and Hatfield, 2001). However, nitrogen compounds also have been associated for their many potential risks to the environment and human health. Water bodies that overload with biologically available nitrogen produce organic materials in abundance.

Nitrogen is identified as responsible for the hypoxia (low oxygen) zone in the Gulf of Mexico, which represents a thread for those who financially depend on fish and shrimp catches. Productive agriculture in the central U.S. is considered the major source of the nitrogen loading to the Gulf (Follet and Hatfield, 2001).

Nitrates are one of the most problematic and widespread of the potential pollutants that can alter water quality. Nitrate standards for drinking water are 10 mg L^{-1} of nitrate-nitrogen (NO_3-N) or 45 mg L^{-1} of nitrate (NO_3) (Canter, 1996). Due to its negative charge (NO_3^-) nitrate is repelled by, rather than attractive to, negatively charged clay mineral surfaces in soil.

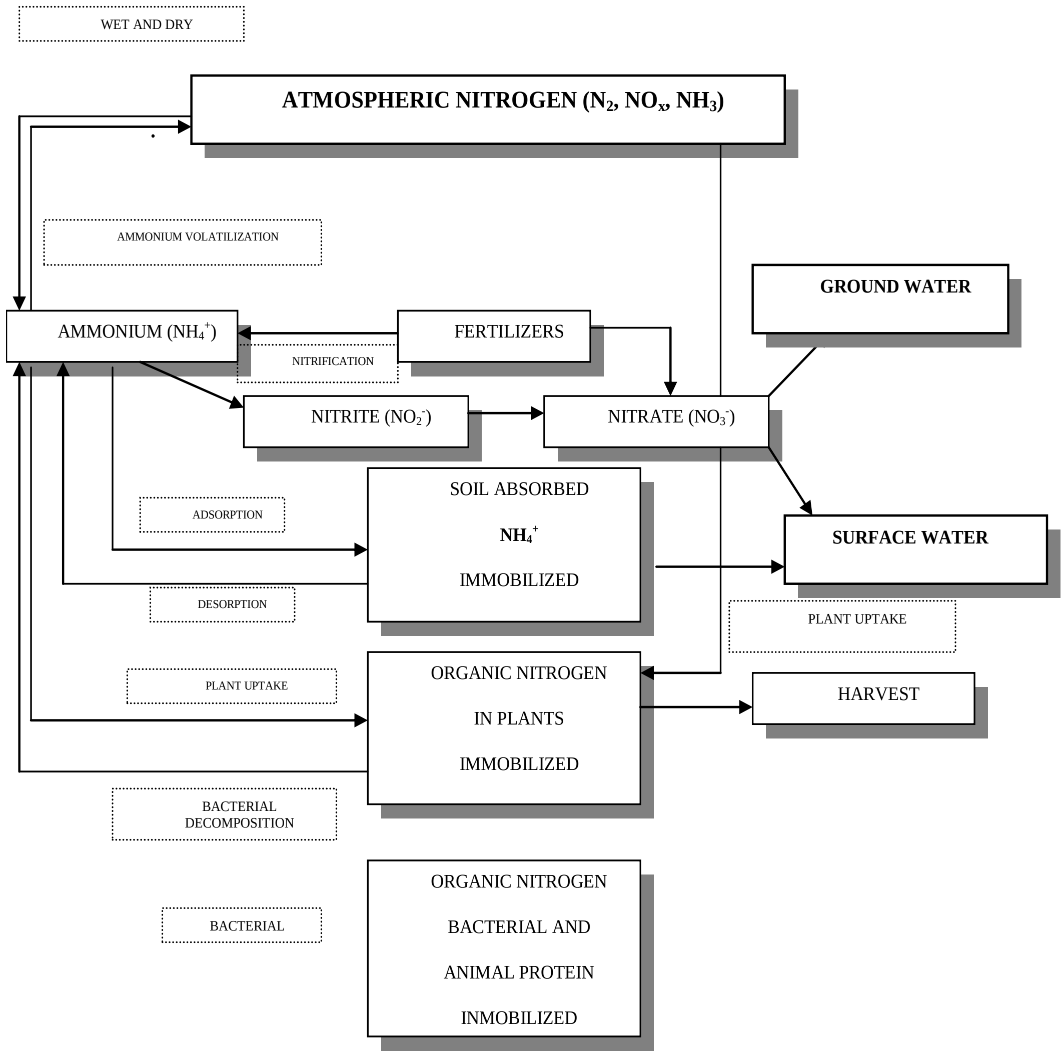


Figure 1.1. Nitrogen Cycle. Modified from Canter 1996.

As a result, nitrates that move below the root zone are totally soluble and can potentially reach groundwater. The concentration of nitrate in ground water is a primary concern due to potential human health impacts.

Phosphorus is a nonmetallic element required for all forms of life. In nature, it is observed as phosphate minerals but it is available as orthophosphate to animals and plants. Phosphates are adsorbed quite strongly to the soil, and therefore, they are associated mainly with the transport of suspended solids (Porcella and Bishop, 1975). Due to its low availability and solubility, phosphates are often a limiting factor for both aquatic and terrestrial natural ecosystem. As a result, phosphorus fertilization may increase productivity, but in the aquatic ecosystem may be involved in the process of eutrophication of water bodies, a condition that decreases the beneficial use of water. Figure 1.2 shows the phosphorus cycle and its fate. A decrease in quality of water has been accompanied by an increase in chemical fertilization; this fact has been cited as a proof that fertilizer usage is related to the increased nutrient supply for surface water. There is a consensus that the majority of the total phosphorus load to water bodies results from surface runoff. The accumulation of phosphorus at the soil surface, in both inorganic and organic forms is highly vulnerable to transport during soil erosion (Porcella and Bishop, 1975).

Sediment is a major pollutant by volume of surface water in Louisiana. It can cause a significant impairment in water quality by reducing light penetration, photosynthesis, aquatic life, and oxygen relationships. Dissolved oxygen (DO) is oxygen gas entrained in the water, and Biochemical Oxygen Demand (BOD_5) is defined as the milligrams of oxygen consumed per liter of solution, or as grams of oxygen consumed per gram of compound, over a period of five days (Houslow, 1995).

Oxygen is necessary to maintain aerobic conditions in surface waters, thus, DO and BOD_5 are primary indicators of the suitability of waters to support aquatic life. Additionally, rainfall runoff from sugarcane fields during the harvest season contains suspended solids, both inorganic and organic material, such as soil particles and small pieces of vegetation, respectively.

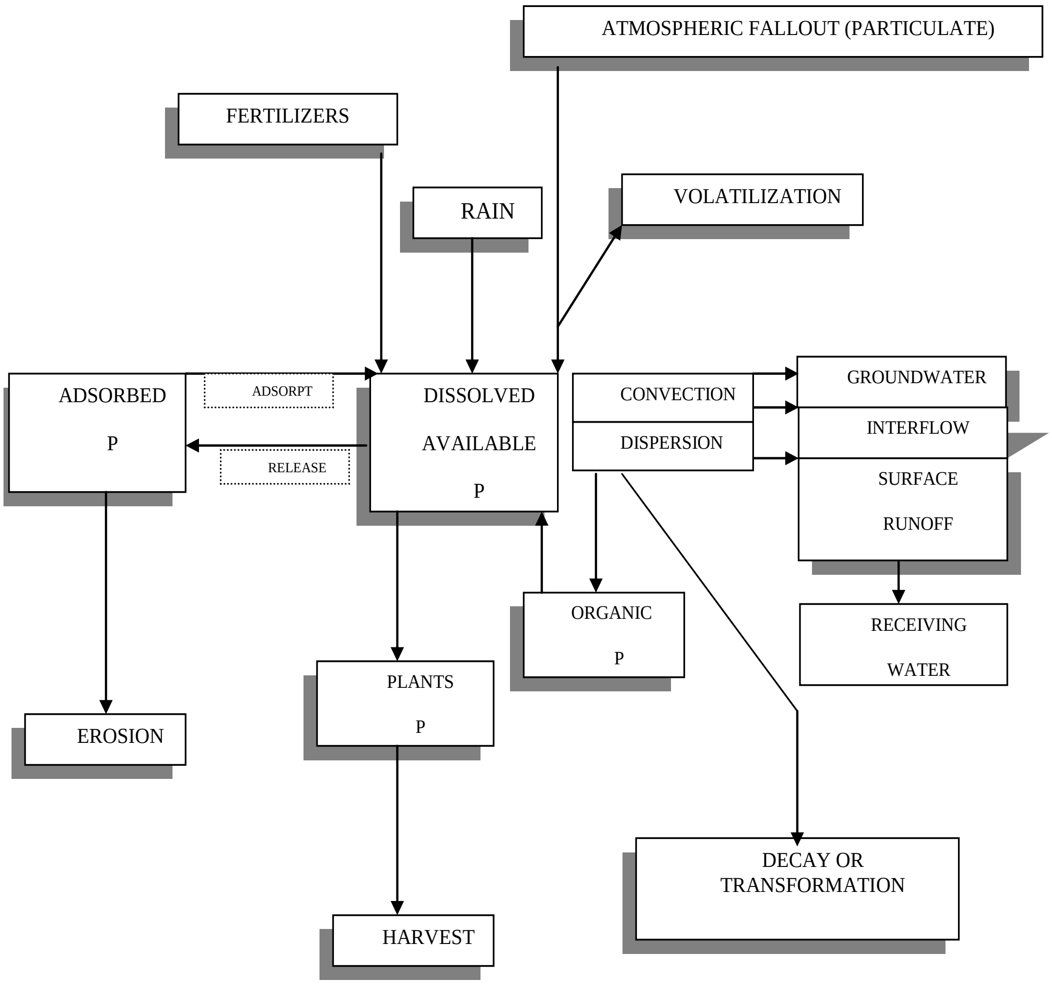


Figure 1.2. The Phosphorus Cycle. Modified from Canter, 1996.

They are an important water quality concern because they cause turbidity, which can be harmful to fish. Furthermore, high values for total suspended solids (TSS), and total dissolved solids (TDS), could cause high BOD reducing oxygen levels. Cook (2003) reported that BOD_5 in water that has been in contact with sugar juice or sugarcane trash can be high. However, it is suggested that incorporating the trash into the soil and keeping the soil moisture when water is available may reduce BOD_5 in runoff water.

Full harvest retention of the residue may have an important impact on reducing the erosion of sediments by reducing runoff. Nitrogen, phosphorus and pesticides losses would likely be reduced by conservation tillage practices under any cropping system (Mikkelson et al., 1994).

Sugarcane is an important-valued row crop in Louisiana. It has been part of the Louisiana economy for more than 200 years (LSU AgCenter, 2000). More than 182,186 hectares were produced in 1999 with a total production of 15,982,000 tons of sugarcane and 1,675,000 tons of sugar, with a production value of $740 million. The direct economic value impact generated from the crop in Louisiana is believed to be about $2 billion (LSU AgCenter, 2000). Two methods are currently used to harvest sugarcane in Louisiana; the first includes cutting the cane with a soldier harvester and laying the cane on heap rows. The cane is then burned to removed shucks and other trash. The second is to use a combine-harvester; the combine harvester cuts the cane into billets ranging from 0.3 m to 0.6 m long. Two extractor fans blow trash and cane shucks out the back and the billets are conveyed into a tractor-drawn wagon running beside the combine (Naquin, 1998). In Louisiana, 75 % of the sugarcane crop is harvested by using a combine system, and it is expected to be 90% by this year (LSU AgCenter, 2000). In both methods, most of the sugarcane is burned in the field before or after harvest to improve harvesting and milling efficiency by eliminating a significant amount of trash leaves. As a consequence, open field burning may have a negative impact on the surrounding environment because it causes air pollution and may cause human health problems. Ripoli (2001) suggested that due to the environmental cost of pre-harvest burning, this practice must be abandoned. One alternative is to use the trash as a source of bioenergy. Natural in situ degradation is an alternative, but microbiological activity in sugar areas is significantly lower than in soils under natural forest. However, since there is not an economical and effective technology to manage the large volume of trash, sugarcane producers are currently allowed to burn (LSU AgCenter, 2000).

Richard (2001) reported that the combine-harvester leaves a green-chopped residue blanket on the soil, which may reduce sugar yields in subsequent crops from 560 to 1400 kg ha^{-1}, if it is not removed from the row or burned. Crop losses for the subsequent crop may reach up to 25% if residue is allowed on the row top until spring (LSU AgCenter, 2000). On the other hand, burning the residue will lead to organic matter, nitrogen, and other nutrient losses. Burning the residue blanket may increase the potential for runoff and sediment transport. Thornburn et al. (2001) found that 86% of nitrogen in the trash blanket, otherwise lost by burning, was either under transformation or exported from the site in harvested cane. Trash blanket may reduce the rate of organic matter depletion, as well as the inputs of inorganic nitrogen fertilizer. Braunack (2001) reported that zero-tillage plus trash-retained practices showed a minimum bulk density increment in a three year period compared to tillage plus burning that resulted in the maximum bulk density increment. Low bulk density values are indirectly related to porosity values which improve air and water movement in the soil profile. Additionally the greatest residue degradation occurred in the burnt cultivated system. Retaining a trash blanket after sugarcane harvest is becoming a common practice in Australia, with climate analogies to Louisiana. Harvest flexibility and erosion management in the wet tropics, and soil moisture retention in arid regions is leading to an acceptance of this practice. Trash blanket retention still presents some management issues (Meier, 2002; Richard 2000). An effective residue-management program may result in a high percentage of green harvested sugarcane, with a subsequent positive impact on the environment by reducing nutrient and pesticides losses through runoff and erosion.

LSU AgCenter, (2000) reported that the percentage of residue-cover impacted inversely the percentage of runoff, runoff velocity, sediment runoff, and soil loss ; i.e., an increase from 41% to 93% coverage resulted in a decrease of : 35.5% runoff, 19% velocity, 3.1% sediment in runoff, and 12.1% of runoff (% of rain), runoff velocity and soil loss (tons/acre), respectively. Furthermore, the decomposition of these residues may improve physical soil properties by adding organic matter into the soil profile.

The practice of sugarcane burning is being critically assessed in the United States because it causes air pollution and public health problems. Public concern has recently increased against sugarcane burning, and alternatives methods are needed to manage the post-harvest sugarcane residue.

Composting has long been viewed as an environmentally beneficial activity and it may be used as an alternative to burning combine residue. Stoffella (2001) described composting as a biological process through which microorganisms transform organic materials into compost. Composts are used increasingly for their nutrient value and ability to build organic matter; improving soil properties and soil conditions including porosity, bulk density, soil structure, infiltration rate, pH, organic matter content, water holding capacity, nutrient availability, and more. These facts may reduce the use of inorganic fertilizers.

Boopathy (2003) conducted an experiment to evaluate in-situ composting as an alternative to open field burning in sugar. The use of molasses as an initial substrate was used to accelerate bacteria and fungi population, which started to decompose the ligno-cellulosic fractions of the residue. Preliminaries results showed that composting of sugarcane residue may be considered as an alternative method to sugarcane burning. Hallmark et al. (2000) conducted preliminary research to evaluate the effect of spraying the combine-residue blanket with nitrogen-stabilized urea which contains urease and nitrification inhibitors. Sugarcane yields were 8090 kg ha^{-1} and 7950 kg ha^{-1} for the combine-residue blanket and the residue burned treatments, respectively. It may be pointed out that the nitrogen-stabilized urea may have eliminated a possible alleleopathic effect of the sugarcane residue (Hallmark, 2000). Certainly, these preliminaries findings suggested that composting should be evaluated as an alternative to burn sugar residue.

Stoffella (2001) suggested that particle size is an important physical property that will not only affect moisture retention but the free air space and porosity of the compost mixture. "Large particle size increases free air space and porosity. However, because aerobic decomposition occurs on the surface of particles, increasing the surface to volume ratio of the particles by decreasing particle size increases composting activity" (Stoffella, 2001). As a result, reduction of sugarcane harvest residue particle size may achieve a higher rate of decomposition.

Many studies have been developed in the field of water quality, sugarcane production, and composting. Few studies have reported on the effect of alternative practices to eliminate the need to burn the combine-residue blanket. This study focuses on methods to assess and potentially reduce water quality issues in sugarcane; improving the sustainability of sugarcane farming through profitable and environmentally acceptable approaches. The purpose of this research is to determine whether methods to manage the residue blanket to avoid the need to burn can be applied to sugarcane production. The results of this research could be useful to educate the public, scientific community and the sugarcane community in the aspects of enhancing sugar production while maintaining a clean and sustainable environment.

1.2. Objectives

1.2.1. General Objective

To enhance with best management practices (BMP's) to reduce the environmentally adverse effects on water quality of sugarcane combine-harvest residue management.

1.2.2. Specific Objectives

- To evaluate the effects of different doses and frequencies of application of compost tea on sugarcane combine-residue degradation rates in laboratory and field conditions.
- To evaluate the impacts of five combine-residues management treatments on runoff water quality and sugarcane yield.
- To develop a reliable, economical and practical runoff water sample collector.

1.3. Research Hypothesis

The spraying of biological compost tea on sugarcane combine-residue blanket will increase its degradation rate reducing the potential of runoff water to transport nutrients and sediments that may impair water bodies, while sustaining suitable sugarcane growth and yield.

CHAPTER 2

COMPOST TEA EFFECTS ON SUGARCANE RESIDUE DEGRADATION RATES: CARBON DIOXIDE (CO_2) EVOLUTION AND RELATED PARAMETERS IN LABORATORY STUDIES

2.1. Introduction

Burning sugarcane residue or trash mat in the field is being critically assessed in the United States because it causes air and water pollution, and public health problems (Sugarcane BMP's 2000). Public concern about sugarcane burning has recently increased, and alternative methods are needed to manage the post-harvest sugarcane residue.

Composting has long been viewed as an environmentally-friendly activity for treating organic wastes and by-products before recycling them into soils. Stoffella (2001) described composting as an aerobic biological process through which microorganisms transform organic materials into compost. Composts are increasingly used for their plant nutritional value and ability to build organic matter; improving soil properties and soil conditions including porosity, bulk density, soil structure, infiltration rate, pH, organic matter content, water holding capacity, nutrient availability, and more. Compost has been also used for fertilization of golf courses, municipal parks, and other recreation areas. These may reduce the use of inorganic fertilizers. The use of aerated composting is an ancient way to reduce wastes and to reuse organic matter (Scheuerell, 2002). However, compost water-extracts also known as compost- tea have been recently used to increase the degradation rate of organic residuals, leading to the development of new compost tea production and uses and generating many potential research opportunities. Compost tea describes many different preparations made using compost as a starting material and producing a liquid extract of the original compost. In other words, compost tea is a concentrated solution of compost in water (Hall et al., 2006).

The idea of applying a variety of water-based compost preparations may prevent plant and soil disease as well as accelerate organic matter degradation. This premise may be based on the fact that composting is an aerobic self-heating biodegradation process of organic based compounds carried out at high rates by diverse population of mesophilic and thermophilic microorganism (Ntougias, et al., 2005). Therefore, microorganism activity is directly linked to organic matter degradation. Several methods have been used to assess organic matter degradation i.e.; mass loss, changes in C/N ratio, changes in hemicelluloses, cellulose and lignin contents, and respiration among others (Tognetti, et al., 2006). Estimating microbial activity by measuring either carbon dioxide (CO_2) evolution or oxygen (O_2) depletion is a standard method to estimate respiration. These measurements have the advantage that “microbial activity” is widely evaluated and directly related to organic matter decomposition (Ntougias, et al., 2005).

Hall and Schellinger, 2006, conducted an experiment to evaluate in–lab sugarcane field residue (trash mat) biodegradation by grinding and using compost tea. Their findings suggest that mechanical chopping significantly increased trash mat degradation rate and adding compost tea may be effective in accelerating decomposition of organic matter. Stoffella (2001) suggested that particle size is an important physical property that will not only affect moisture retention but the free air space and porosity of the compost mixture.

Boopathy (2003) evaluated in-situ composting as an alternative to open field burning in sugar. The use of molasses as an initial substrate was used to accelerate bacteria and fungi population, which then started to decompose the ligno-cellulosic fractions of the residue. Preliminary results showed that composting of sugarcane residue may be considered as an alternative method to sugarcane burning. However, since these results were preliminary, additional information is required on compost tea concentrations to determine the extent of sugarcane degradation.

The purpose of this study was to evaluate the effects of compost tea application rate and sugarcane trash mat size on sugarcane residue blanket degradation rate. Therefore, laboratory experiments were carried out and carbon dioxide evolution rate and related parameters were examined.

2.2. Materials and Methods

The experiment was carried out in The W.A. Callegari Environmental Center in Baton Rouge, Louisiana. The Callegari Laboratory is capable of performing organic waste and compost analysis using the United States Composting Council Test Methods (USCC). Composting was prepared at the Callegari Center. Sugarcane trash-mat was used as a base component for compost, following preliminary research conducted by Hall and Schellinger in 2006. Other composting materials were available at the Callegari Environmental Center and local nurseries.

The feedstock was formulated based on the USCC recommendations with a minimum of 120 days of composting process ssure sufficient maturity and high mineralization stability (Boopathy, 2003).

The windrow was turned 3-4 times weekly by using a wildcat turner. Randomized samples were collected from the windrow to prepare the compost-tea. Good compost has the potential to make a good compost tea if done properly; poor compost will always make a poor compost tea. A good quality compost tea will provide beneficial microorganism and nutrients to assist in organic matter degradation (Bess, 2000). Table 2.2 displays the components used to prepare the compost tea.

Table 2.1 shows the components and amounts used to prepare the compost mix.

Table 2.1. Compost mix components.

Components	Quantity (m^3)
Sugarcane Bagasse,	1.7
Chopped Corn + 10% Cotton seed.	5.6
Chipped wood,	3.4
Poultry litter,	2.4

The above components were deposited in a 208 liter drum and water was added to prepare a 114 liter batch. Air was injected by means of an air-pump at a rate of 425 $m^3 h^{-1}$ to ensure the production of aerated compost tea (ACT). The compost tea temperature was maintained at 21^oC for a minimum of 36 hours. This process is commonly referred as "brewing". The procedure was based on the bucket-bubbler method described by Ingham and cited by Hall et al., (2006). After bubbling, the compost tea is filtered through a grain sack and a strainer to remove suspended solids. Compost tea sub-samples were taken for biological (fungal and bacterial) and chemical analysis.

Table 2.2. Compost tea components and quantities.

Components	Quantity
Compost, kg	4.7
Humus, g	315
Commercial fish emulsion, ml	158
Molasses, ml	315
Tap water, l	83

Fresh trash-mat was collected from sugarcane fields where a regular combine harvester was used, and compared with a new shredder-based device that has been adapted to the combine-harvester. This shedder approach was based on earlier findings suggesting that particle size is an important physical property that affects the degradation rate of sugarcane residue (Stoffella, 2001). Three replications of shredded and conventional intact trash-mat were weighted and put into 1-liter-jars, where moisture contents were adjusted to between 45% and 55%. Four doses of compost tea were applied to the trash-mat: 0, 2.8, 5.6, and 11.4 m^{3} $hectare^{-1}$ (0, 750, 1500, and 3000 gal $hectare^{-1}$), respectively. As a result, eight treatments with three replications were evaluated for carbon dioxide evolution (mg CO_2-C), as a measure of organic carbon degradation. Method 05.08-B Carbon Dioxide Evolution Rate (Thompson, 2002) was selected to estimate microbiology activity in each treated jar. The test estimates the amount of CO_2 released biologically from a compost sample as a result of standardized incubation under ambient fluctuating temperatures within a non-climate controlled structure. Ten ml of an alkali trapping of sodium hydroxide (NaOH) was placed in each of the jars, which were incubated at ambient temperature. Every week, the NaOH containing trap was removed and titrated with HCl (0.5N). Alkali-traps were replenished with NaOH and placed back into each jar for the next one-week incubation period. Carbon dioxide production rate (mg CO_2-C gr^{-1}DW h^{-1}), nitrogen activity (pH) and microbiological population were determined. Analysis of variance and difference significant test were performance on the results using SAS 9.13 (2006) software. A complete detail of the test method is described on the United States Composting Council Test Methods 05.08-B Carbon Dioxide Evolution Rate (Thompson, 2002).

2.3. Results and Discussion

Table 2.3 summarizes CO_2 evolution rate for conventional and shredded sugarcane trash-mat exposed to different concentrations of compost tea during in-vitro aerobic incubation. Average CO_2 evolution rate (mg CO_2-C gr^{-1}DW) showed a tendency to increase when compost tea concentration were increased from 0 to 5.6 m^3 $hectare^{-1}$. However, the analysis of variance reported that CO_2 evolution rate did not significantly increase further when the compost tea concentration was increased to 11.4 m^3 $hectare^{-1}$ for sh. A similar pattern was established for the shredded material; however, CO_2 evolution rates were lower for each corresponding treatment compared to the effects of compost tea concentrations on conventional (non-shredded) material. The findings do not support the theory that reducing the size of material will increase the degradation rate. A shredded material may lose water and show smaller bulk pore aeration which may negatively affect microbial activity (Stofella, 2001). Differences in total CO_2 evolution rate were tested for significance by ANOVA. However, no significant differences were found ($p<0.05$).

Carbon dioxide evolution rates for non-shredded material (conventional trash-mat) during the incubation period are presented in figure 2.1. The general tendency shows an increasing microorganism activity, which reached their peaks in the first 30 days of incubation for all treatments. Afterwards, a decline continued during the next 30 days and recovery to the end of the 80-days incubation period. This may be explained by considering the availability of nutrients such as carbon, nitrogen and phosphorous and it may also indicate an increase of organic matter stability (Tognetti, 2005). This trend is similar to results from composting studies reporting that microorganism activity increases during the first 28-30 days of composting incubation (Hall and Schellinger, 2006); which is also related to a thermophilic phase (60-70 ^oC), followed by periods of mesophilic temperatures (30-40 ^oC). As shown in Figure 2.1, CO_2 evolution rates show a similar trend for all treatments.

All samples began with a rise in CO_2 evolution rates for 30 days, a decline then continued and a recovery to the end of the incubation period. However, the application of compost tea does not necessarily correspond directly to an increase in microorganism activity (CO_2 evolution rates). No-treatment (0 m^3 $hectare^{-1}$), as well as the highest concentration treatment (11.4 m^3 $hectare^{-1}$) showed lower CO_2 evolution rates compared to application rates of 2.8 and 5.6 m^3 $hectare^{-1}$. This behavior may be explained by the population of microorganism in each application rate. Parada et al., 1983 indicated that active carbon may be a limiting factor due to the predominant presence of heterotrophic microorganisms. Excessive population may be limited by a change in pH affecting microorganism activity, which may explain the reduction on CO_2 fluxes when higher concentrations are used.

Table 2.3 Total Carbon dioxide evolution rate for conventional and shredded sugarcane trash-mat at different concentration of compost tea. Callegari Research Center, LA. December 2005-March 2006.

Treatments, m^3 $hectare^{-1}$	Total carbon dioxide, mg CO_2-C gr^{-1}DW			
	Mean	Minimum	Maximum	Std. Dev
Conventional: 0	3.9	3.8	4.1	0.11
Conventional: 2.8	4.0	3.3	4.6	0.64
Conventional: 5.6	4.5	4.2	4.8	0.27
Conventional: 11.4	4.0	3.4	5.1	0.91
Shredded: 0	3.5	3.1	3.8	0.37
Shredded: 2.8	3.6	3.5	3.8	0.17
Shredded: 5.6	3.5	3.3	3.7	0.19
Shredded: 11.4	3.5	3.1	4.0	0.42

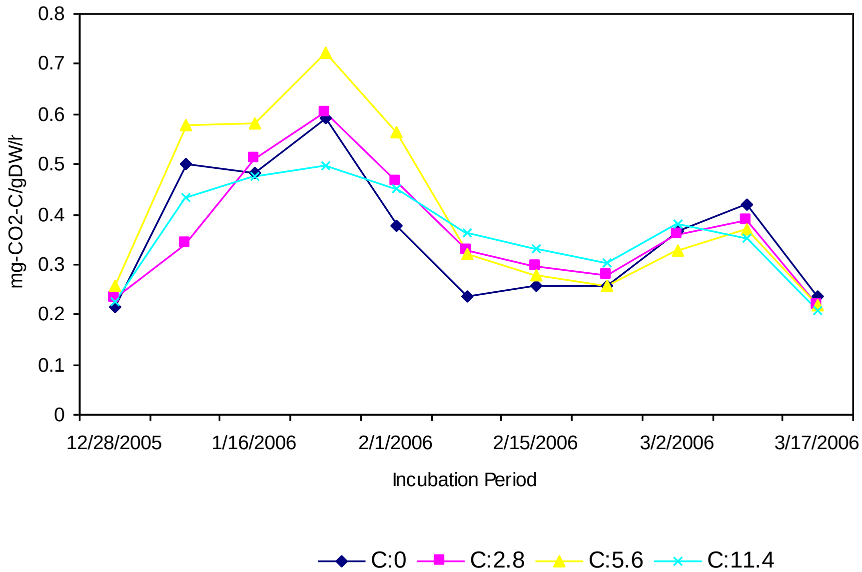


Figure 2.1 Carbon dioxide evolution rates for conventional (C) trash-mat under four compost tea concentrations. Callegari Research Center, LA. December 2005-March 2006.

The highest CO_2 evolution rates and total carbon dioxide production were achieved by applying 5.6 m^3 $hectare^{-1}$ of compost tea to a non-shredded material (conventional trash-mat). Figure 2.2 shows the carbon dioxide evolution rate (mg CO_2-C gr^{-1}DW h^{-1}) for shredded materials under four concentrations of compost tea, during an 80-day aerobic incubation period.

The incubation began with low level CO_2 evolution rates for the first week. Afterwards, shredded material displayed a similar pattern compared to the non-shredded material (figure 2.1), but with lower CO_2 evolution rates. It is important to point out that in the case of shredded material the highest CO_2 evolution rates were achieved when applying 2.8 m^3 $hectare^{-1}$ instead of 5.6 m^3 $hectare^{-1}$ as was pointed out for the non-shredded material.

Reducing the size of the particles and increasing the contact surface of the material may had a positive effect on the shredded material.

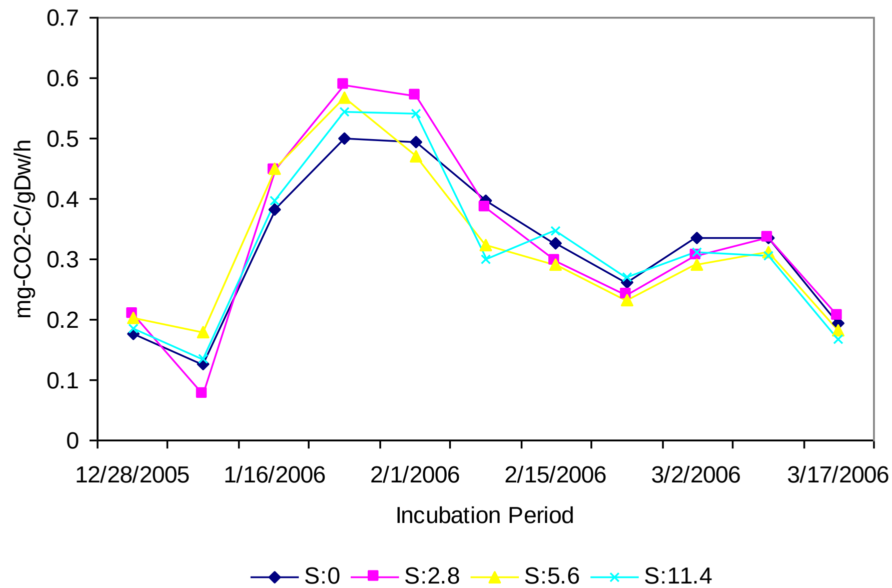


Figure 2.2 Carbon dioxide evolution rates for shredded (S) trash-mat. Callegari Research Center, LA. December 2005-March 2006.

As shown in figure 2.3, the CO_2 evolution rates of non-shredded material (C: 2.8 and C: 5.6 m^3 $hectare^{-1}$) presented higher and increasing CO_2 evolution rates for the first 30 days compared to shredded materials (S:0 and S:2.8 m^3 $hectare^{-1}$). Afterwards, both materials showed a similar decline and a recovery for the 80-days incubation period. The findings may represent temporary microorganism dormancy and adaptation to a new environment (Zhang, 2005). It is important to point out that peak CO_2 evolution rates for shredded material were reached later (40-60 days after the initial time) compared to 30 days for non-shredded material.

The results are consistent with earlier studies on composting improvement that suggest a longer and more intensive thermophilic phase on non-shredded compost materials may be the result of an extensive organic N-ammonification (Tognetti, 2005). By day 80, sugarcane residue stability was assumed and incubation period was finished.

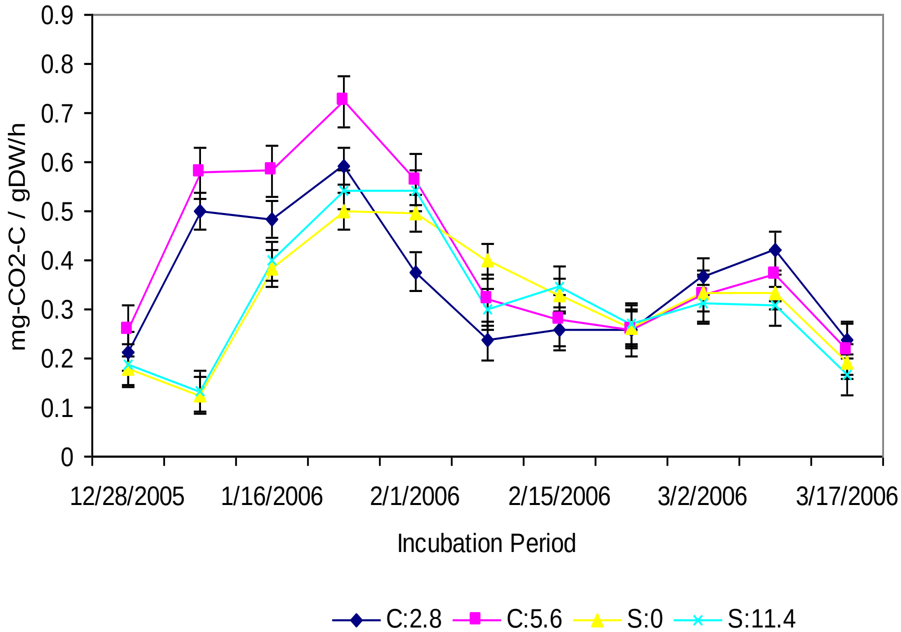


Figure 2.3 Comparison between Conventional and Shredded treatments for carbon dioxide evolution rate. Callegari Research Center, LA. December 2005-March 2006.

2.4. Conclusions

This study has taken a step in the direction of using compost tea as an alternative to accelerate organic matter degradation. Previous studies (Hall and Schellinger in 2003) showed that grinding sugarcane residues (trash –mat) may increase organic matter degradation and have positive effects on the trash-mat left in field after sugarcane harvest. Our study, reported that carbon dioxide evolution rates (mg CO_2-C gr^{-1}DW h^{-1}) increased when applying compost tea to a shredded and non-shredded material under laboratory conditions; whereas no significant differences ($p<0.05$) were found among treatments. The highest degradation rate was found when applying a dosage of 5.6 m^3 $hectare^{-1}$ for a non-shredded material and 2.8 m^3 $hectare^{-1}$ for shredded material. The present paper demonstrates that compost water-extracts also known as compost tea increased the degradation rate of organic residue and it could lead to a new important research to manage sugarcane residues and become part of good agricultural practices to reduce the negative effects of open field burning from sugarcane farms.

CHAPTER 3
DEGRADATION KINETICS OF SUGARCANE RESIDUE IN-SITU (ST. GABRIEL)

3.1. Introduction

Global carbon dioxide emissions are considered the main greenhouse gases, with the primary source from fossil fuels (6.5 Gt C Yr^{-1}) and deforestation (1.6 Gt C Yr^{-1}). Regular soil respiration is approximately balanced by photosynthetic uptake of carbon dioxide (CO_2) to produce biomass. However, CO_2 uptake may exceed soil respiration during vegetative cropping (Maddock, et. al; 2004). Soils are the largest source of non-anthropogenic CO_2 and short-term changes in soil atmospheric exchange are commonly affected by external environmental land use modifications (Kellman and Beltran, 2006). Humus and crop residue mineralization are controlled by abiotic factors such as climate and soil properties (Alvarez and Alvarez, 2001). The production of CO_2 in soil is affected by temperature and moisture conditions (Kellman and Beltran, 2006). Furthermore, biotic factors such as organic matter content and microbiological activity also have major effects on CO_2 fluxes production. Soils carbon dioxide flux is the result of plant root respiration and microorganism such as bacteria, fungi, worms and insects, which metabolize the soil organic carbon (Maddock, et. al; 2004). According to Hogbert et al. 2001; microbial and root respiration would add 50% of the annual soil respiration. Nonetheless, CO_2 flux presents diurnal and seasonal variations, which magnitude is specific for the ecosystem i.e., average annual CO_2 fluxes from a grassland were estimated at 1.5 to 5.9 kg CO_2 m^{-2} yr^{-1}, 4.8 kg CO_2 m^{-2} yr^{-1} for a tropical forest and only 0.73 kg CO_2 m^{-2} yr^{-1} for deserts (Lou et. al, 2003).

Biological processes including root respiration and decomposition of organic matter by microbial action may contribute to diurnal and seasonal CO_2 variations. Carbon dioxide evolution can be used as an index of organic matter decomposition in specific ecosystem (Risch and Frank, 2005). The microbial activity is soil-temperature dependent; according to earlier findings by Parada et al., (1983) CO_2 fluxes in that study increased 1.5 to 3 times for every 10 ^oC increase in temperature from 0 to 50 ^oC. Soil moisture content also affects CO_2 fluxes by influencing gas diffusion and microbial activity. Due to the predominant present of heterotrophic microorganisms active carbon is a limiting factor.

Recently, Hall and Schellinger (2006) conducted an experiment to evaluate *in-lab* biological process to enhance *in-situ* degradation of the sugarcane harvesting residue or "trash-mat". According to earlier findings conducted by Richard (1998), trash mat left in the field will affect the growth and subsequent yield of the next crop. As a result, farmers are allowed to use open field burnings to eliminate the sugarcane residue, despite the emission of air pollutants and the public concern about related respiratory health problems.

Hall and Schellinger findings suggest that mechanical chopping significantly increased trash mat degradation rate. Adding compost tea may be effective in accelerating decomposition of organic matter.

Boopathy (2003) evaluated *in-situ* composting as an alternative to open field burning in sugarcane. Molasses was used as an initial substrate to accelerate bacteria and fungi population, which then started to decompose the ligno-cellulosic fractions of the residue. Preliminary results showed that composting of sugarcane residue may be considered as an alternative method to sugarcane burning.

On the other hand, microbial activity plays an important role in degrading agrochemicals, resulting in a sustainable soil health (Critter et. al., 2003). Despite the number of studies on soil CO_2 emissions few studies have reported on the effect of using compost tea as an alternative to increase the degradation rate of sugarcane trash-mat in the field. The purpose of this study was to evaluate the effects of doses and frequency of doses of compost tea application on sugarcane combine residue in open field conditions.

3.2. Materials and Methods

The study was conducted after harvesting the cane in the crop season of 2006 and 2007 in the St. Gabriel Research Station located in Iberville Parish, Louisiana about 10 miles south of Baton Rouge. This area is representative of sugarcane fields in Louisiana. The cropped site represented a traditional harvested combine system, since this method is used on more than 75% of sugarcane production areas in Louisiana (Sugarcane BMP's, 2000). Full post-harvest retention of the residue was required to evaluate the effects of compost tea on CO_2 fluxes as an index to measure organic matter degradation. A split plot design with three replications on a complete block design arrangement was used to analyze the data. Four compost tea concentrations: 0, 2.8, 5.6, and 11.4 m^3 ha^{-1} were applied to big plots, and three application frequencies: 1, 2, and 3 to small plots. A total of 36 experimental units (2 m x 1 m) were evaluated (Appendix D shows planning map at St Gabriel). Treatments were applied after the sugarcane field was harvested and applications were applied every month for a maximum of three months (3 applications). An experimental unit of 1 m^2 (1 m x 1 m) was marked to apply the treatments. Soil temperature and CO_2 fluxes (μmol CO_2 m^{-2} s^{-1}) were measured by using a soil thermometer and a soil CO_2 fluxes chamber (IRGA-model LI-6400-09).

The CO_2 flux chamber (Figure 3.1.) is a portable infrared analyzer used to determine CO_2 accumulation. The CO_2 flux chamber has been designed to minimize perturbation in the soil-gas concentration gradient. Ambient CO_2 concentration at the soil surface is measured. Once installed, the CO_2 scrubber is used to draw the CO_2 into the closed system. The chamber, 25.5

cm in diameter and 31 cm high, was settled on circular collars installed in the field at depth of 3-5 cm into the soil. The use of collars reduces the disturbance effects caused by inserting the chamber directly into the soil. Collars were installed at least 6 hours before making measurements; one collar was installed for each treatment. To avoid extreme temperatures, readings were measured early in the morning or late in the afternoon. Due to equipment availability a single reading was carried out after three months of treatments application.
All suitable statistical analysis i.e. analysis of variance (F-test), hypothesis testing and confidence limits; were performed to determine any significance among treatments.

3.3. Results and Discussion

Table 3.1 summarizes the descriptive statistics for soil carbon dioxide fluxes for different doses and compost tea application for 2006 and 2007 experimental phases.

Average CO_2 fluxes (μmol m^2 s^{-1}) showed a tendency to increase when compost tea concentration were increased from 0 to 5.6 m^3 $hectare^{-1}$. However, CO_2 fluxes did not significantly increase when the compost tea concentration was increased to 11.4 m^3 $hectare^{-1}$. This behavior may be explained by the population of microorganism in each application rate, and as indicated by Parada et al, (1983. Active carbon may be a limiting factor due to the predominant presence of heterotrophic microorganisms.

Excessive population may be limited by a change in pH affecting microorganism activity, which may explain the reduction of soil-CO_2 fluxes when higher concentrations and numbers of applications are used. It is important to point out that open field findings are congruent with the pattern observed for the carbon dioxide evolution rate tendency under controlled ambient (In-lab experiment-Callegari Research Station) for conventional material. The 2007 data shows a similar pattern, however, soil carbon dioxide fluxes increased. This may be explained by the temperature effects on soil-CO_2 fluxes.

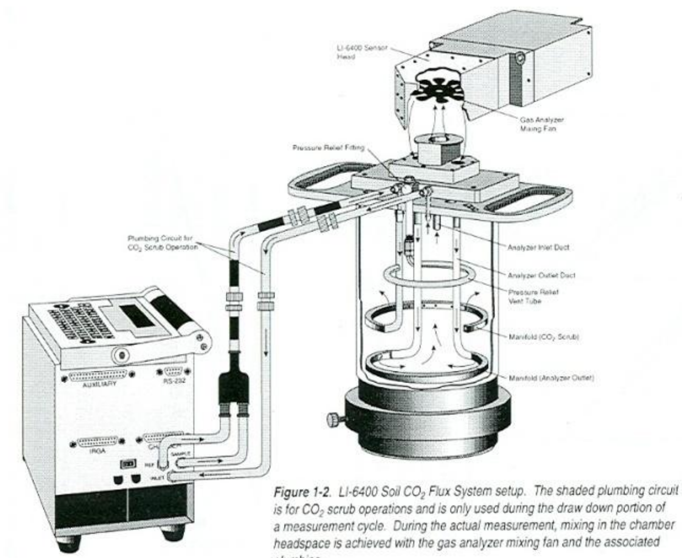


Figure 1-2. LI-6400 Soil CO_2 Flux System setup. The shaded plumbing circuit is for CO_2 scrub operations and is only used during the draw down portion of a measurement cycle. During the actual measurement, mixing in the chamber headspace is achieved with the gas analyzer mixing fan and the associated plumbing.

Figure 3.1 LI- 6400-09 Soil CO_2 Flux Chamber
Taken from IL-6400-09 Soil CO2 Flux Chamber Manual, 1997

The 2006 soil-CO_2 fluxes were measured late in March, where environmental temperatures are still lower compared to the temperatures in May-2007. This behavior supports earlier findings about microbial activity being soil-temperature dependent (Parada et al., 1983).

Figure 3.2 shows the soil carbon dioxide fluxes for different doses and compost tea applications for 2006. Average soil-CO_2 fluxes (µmol m^2 s^{-1}) showed a tendency to increase when compost tea concentrations were increased from 0 to 2.8 m^3 hectare^{-1}. However, soil-CO_2 fluxes start decreasing when a higher concentration was applied to the trash-mat. It is important to point out the tendency when applications are considered individually; when using a lower dosage, i.e. 2.8 m^3 hectare^{-1} having more than one application showed a positive effect on soil-CO_2 fluxes as an indication of organic matter degradation. Nonetheless, when compost tea concentration was increased to 11.4 m^3 $hectare^{-1}$ the positive effect on degradation decreased.

Table 3.2 shows Tukey means grouping for doses during 2006 and 2007. The analysis of variance for soil-CO_2 fluxes in table 3.2 indicates statistically differences among dosages ($P=0.05$). Applying compost tea has an impact on degradation rate of sugarcane residue compared to non-application.

However, the positive effects decreased when the dosage increased to 11.4 m^3 $hectare^{-1}$. Based on the results applying 2.8 m^3 $hectare^{-1}$ or 5.6 m^3 $hectare^{-1}$ does have the same significant effect when compost tea was applied early in the fall. On the other hand, the findings suggest that when compost tea was applied early in the spring, soil carbon dioxides fluxes were increased up to 66% compared to fall applications in 2006; This tendency is supported by early findings showing that production of CO_2 in soil is mainly affected by temperature and moisture conditions.

A slight tendency to produce a greater effect was observed in 2007 when increasing the dosage. Compost tea management may not indicate a feasible practice, due to the volumes required to achieve an increased CO_2 rate. Similar behavior is observed in table 3.3 when applications are considered individually.

Two applications of compost tea may represent a better practice in combination with 2.8 m^3 $hectare^{-1}$. Since, higher volumes and applications may not represent an economical practice. The findings suggest that microbiological activity may have a major affect on CO_2 fluxes production, when applied early in the spring compared to early in the fall. It seems that fractioning the dosage of 5.6 m^3 $hectare^{-1}$ in two applications during the early-spring may produce the more significance effect on the sugarcane trash mat degradation rate. It is important to point out that compost tea applications were separated one month from each other.

Table 3.1 Soil Carbon dioxide flux from sugarcane trash-mat at different concentrations of compost tea and applications. Saint Gabriel Research Station, LA. March 2006/May 2007.

Treatments		**Soil Carbon Dioxide Flux, µmol m^2 s^{-1}**							
		2006				2007			
Dosage, m^3 ha^{-1}	**Applications**	Average	Max	Min	Std. Dev.	Average	Max	Min	Std. Dev.
0	1	0.74	0.90	0.51	0.204	1.84	1.90	1.81	0.052
	2	0.90	0.91	0.90	0.006	1.93	2.10	1.80	0.153
	3	0.51	0.57	0.47	0.049	1.84	2.10	1.56	0.270
2.8	1	1.23	2.1	0.6	0.802	1.42	1.68	1.28	0.225
	2	0.97	1.2	0.6	0.283	2.97	3.56	2.39	0.585
	3	1.41	1.9	0.8	0.574	3.11	3.83	2.60	0.643
5.6	1	1.07	1.3	0.8	0.239	2.62	3.86	1.65	1.129
	2	1.18	1.6	0.9	0.362	3.08	4.74	1.56	1.594
	3	1.01	1.3	0.6	0.348	2.61	2.85	2.43	0.216
11.4	1	0.83	1.4	0.4	0.503	2.39	2.7	1.9	0.462
	2	1.24	1.5	0.8	0.366	2.98	3.7	2.0	0.883
	3	0.83	1.2	0.4	0.388	3.14	3.72	2.27	0.769

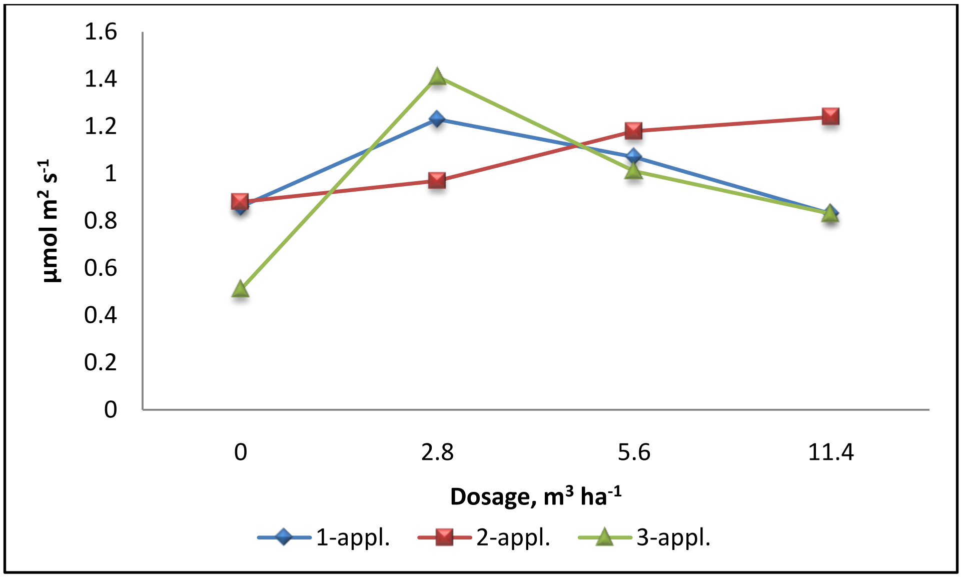


Figure 3.2 Soil carbon dioxide fluxes for trash-mat. Saint Gabriel Research Station, LA. March 2006.

Table 3.2 Tukey grouping for soil carbon dioxide flux from sugarcane trash-mat at different concentration of compost tea. Saint Gabriel Research Station, LA. March 2006/May 2007.

	Soil Carbon Dioxide Flux, µmol m^2 s^{-1}		
Treatments	2006	2007	
Dosage, m^3 ha^{-1}	Mean	Mean	Difference 2006-2007
0	0.7193b	1.87c	62%
2.8	1.2046a	2.49b	52%
5.6	1.088a	2.77ba	61%
11.4	0.9657ab	2.84a	66%

Treatments with same letters are not significant (alpha<0.05)

Table 3.3 Tukey grouping for soil carbon dioxide flux from sugarcane trash-mat at different compost tea applications. Saint Gabriel Research Station, LA. March 2006/May 2007.

	Soil Carbon Dioxide Flux, µmol m^2 s^{-1}		
Treatments	Fall-2006	Spring-2007	
Applications	Mean	Mean	Difference 2006-2007
0	0.7193b	1.87c	62%
1	1.042ba	2.14b	51%
2	1.0849a	3.05ba	64%
3	1.1313a	2.95a	62%

Treatments with same letters are not significant (alpha<0.05)

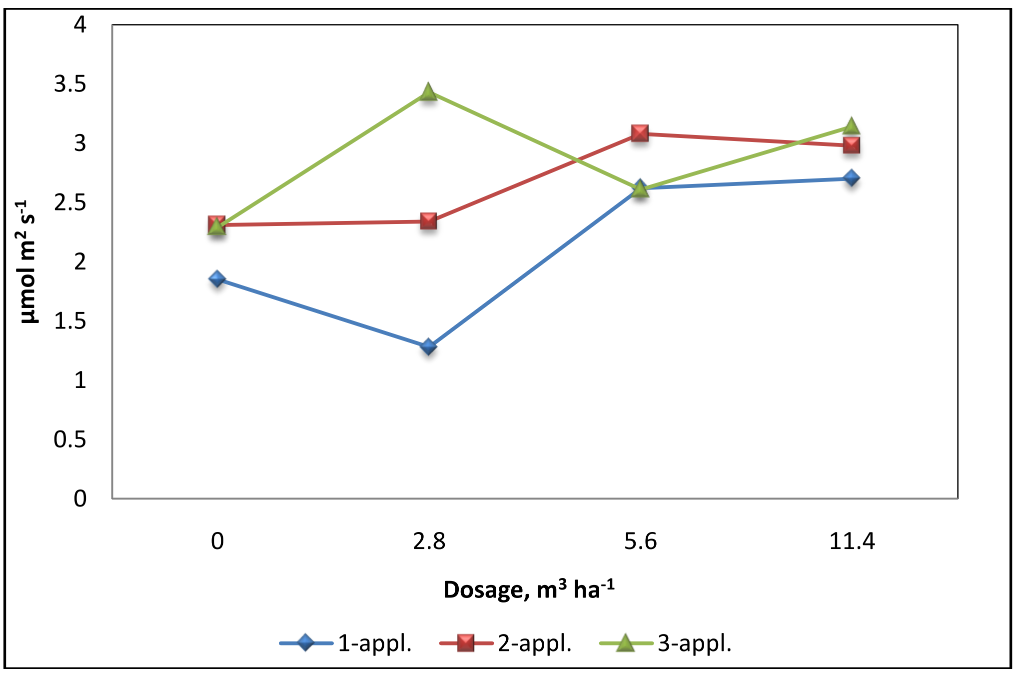


Figure 3.3 Soil carbon dioxide fluxes for trash-mat. Saint Gabriel Research Station, LA. May 2007.

Figure 3.3 shows the soil carbon dioxide fluxes for different doses and compost tea application for 2007. It can be observed that average soil-CO_2 fluxes (µmol m^2 s^{-1}) showed a similar pattern compared to 2006 data. Once again, the findings suggest that applying. 2.8 m^3 $hectare^{-1}$ twice after cane harvest showed a positive effect on soil-CO_2 fluxes as an indication of organic matter degradation.

3.4. Conclusions

Soil-CO_2 fluxes showed a seasonal pattern which is mainly affected by soil temperature, and the application rate of compost tea. It is out of the scope of this experiment to establish the extent to which weather factors impact soil-CO_2 fluxes the most. However, seasonal tendencies may be taken into consideration when considering biological compost tea as a BMP to accelerate sugarcane trash-mat in the field. Furthermore, the findings support previous research confirming the use of *in-situ* composting as an alternative to open field burning in sugar, when molasses was used as initial substrate to accelerate bacteria and fungi population, which then started to decompose the ligno-cellulosic fractions of the residue (Boopathy, 2003). The results reported that soil carbon dioxide fluxes (µmol m^2 s^{-1}) as an indication of organic matter degradation; were significantly increased when applying compost tea to sugarcane residue left in the field. The most practical degradation rate may be achieved when applying a dosage of 2.8 m^3 $hectare^{-1}$ two times during the spring. The present research demonstrates that compost water-extracts also known as compost tea increases the degradation rate of organic residue and it could lead to further research to understand and model the use of this novel technology to reduce potential environmental impacts. Soil microorganisms may favor long-term soil sustainability by positively affecting physical and chemical characteristics and by degrading many agrochemicals which may represent a potential threat to natural ecosystems.

CHAPTER 4
SUGARCANE RESIDUE MANAGEMENT EFFECTS ON WATER QUALITY

4.1. Introduction

Water pollution is one of the most critical natural resource problems in the world, and this condition will get worse as impacts increase. Groundwater is the source of drinking water to about 50% of the overall population in the United States, and over 90% of the rural population (Canter, 1996). The importance of groundwater in the overall water cycle that relates to the improvement is cultural, and economic activities cannot be neglected. Water sources can be contaminated by several pollutants, i.e. chemical, physical, and biological pollutants. The sources of pollution can be classified as point and non-point source (Krenkel, 1980). Point sources release pollutants to water bodies at discrete and identifiable locations, i.e., industrial and municipal wastewater treatment plants, solid waste deposition sites or other fixed sources. Non-point sources are diffuse sources of pollutants that , may originate from natural process such as weathering of minerals, erosion of virgin lands and forest, or from artificial sources such as those related to man's activities, i.e., household products, fertilizer application, agricultural chemicals, erosion and transportation of soil material from agricultural areas. Agriculturally originated non-point sources are considered to be unintentional, because soil loss affects productivity over time. Nitrogen and phosphorus compounds present in fertilizers may be also involved in the process of eutrophication of water bodies. The principal active agent present in pesticides and herbicides may be found in surface and ground waters or adsorbed to soil or sediments. The beneficial use of mulch as a soil conservation practice and the presence of mulch residue left on the soil surface of sugarcane fields is still being investigated. Richard and Johnson (2003); reported that leaving the residue in the field may be responsible for as much as 14% reduction on sugarcane yield.

As a result, open field sugarcane burning is a common practice for sugarcane producers, which has an expected detrimental impact on air quality. Burning may also result in loss of organic matter, nitrogen, phosphorus, and other nutrients as a result of sediment transport, when mulch residue is burned and the soil surface exposed to the physical action of rainfall and runoff (Bengston and Selim, 2006). The practice of sugarcane burning is being critically assessed in the United States because it causes air pollution and public health problems. Public concern has recently increased against sugarcane burning, and alternatives methods are needed to manage the post-harvest sugarcane residue.

Composting has long been viewed as an environmentally beneficial activity and it may be used as an alternative to burning combine residue. Stoffella (2001) described composting as a biological process through which microorganisms transform organic materials into compost. Composts are used increasingly for their nutrient value and ability to build organic matter; improving soil properties and soil conditions including porosity, bulk density, soil structure, infiltration rate, pH, organic matter content, water holding capacity, nutrient availability, and more. These facts may reduce the use of inorganic fertilizers. This study has the objective to evaluate the impacts of five combine-residue management treatments on runoff water quality, sugarcane growth, and yield.

4.2. Materials and Methods

A sugarcane residue management trial was conducted at Youngsville, Lafayette, LA. Research plots were installed in January 2006 and the sampling phase was continued until May 2007. The soil at this site is mapped as a Memphis silt loam. The Memphis series consist of very deep, moderately permeable, well drained soils. A randomized complete block design was installed to evaluate five residue management treatments with four replications: Ground burning of trash mat (GB), Compost tea+ Stabilized Urea (CU), Shredded Material (SM), Compost Tea (CT), and Full post-harvest retention of trash mat (FHR). See appendix E for planning map details. The experimental units consisted of five cane rows; 30 m long and 4 m wide. Samplings units for yield consisted of the three central rows. These rows were collected by means of a weigh-wagon mounted on electronic load cells. Ten randomized cane stalks were sampling from the center row for overall analysis of polarization (Pol), fiber, refractometric dry solids (RDS) and Brix. These parameters give an indication of how much sugar is present in the cane delivered to the mills. Raw juice analysis was conducted by the LSU AgCenter's St. Gabriel Research Station. Due to overall project funding limitations only two replications were used to evaluate water quality parameters. Agronomic and soil information were collected from all four replications. Initially, a novel water system collector was evaluated at Youngsville for water sampling. Chapter five covers the detailed design, construction and operation of this collector. The new sampler system did not meet overall project goals then automated water samplers (ISCO 6712) were installed to sample runoff water on two replications. Sampling events between January 2006 and May 2007 were collected following rainfall occurrence. Water quality parameters collected in the field included: Electrical conductivity, temperature, pH, and dissolved oxygen (DO). Others parameters like total suspended solids (TSS), total dissolved solids (TDS), total solids (TS), fixed solids (FS), volatile solids (VS), turbidity, total Kjeldahl nitrogen (TKN), NO_3^- -N and NO_2^- -N, dissolved phosphorous (DP), and biological oxygen demand (BOD_5); were analyzed in the laboratory at The Louisiana State University, Agronomy Department. A Quality Assurance Project Plan (QAPP) and quality control and quality assurance procedures were maintained throughout data collection and the analysis process. For water quality assessment in particular, sample preservation and transport was conducted in accordance with LDEQ protocol and the QAPP. A weather station was installed to monitor rain events on site. Actual readings were able to observe by satellite communication.Soil temperature and CO_2 fluxes (µmol CO_2 m^{-2} s^{-1}) were measured by using a soil thermometer and a soil CO_2 fluxes chamber (model LI-6400-09). A LI-6400-09 CO_2 flux chamber is a portable infrared analyzer used to determine CO_2 accumulation in sealed chambers. The CO_2 flux chamber measurement device was designed to minimize perturbation in the soil-gas concentration gradient. Ambient CO_2 concentration at the soil surface was measured. Once installed, the CO_2 scrubber is used to draw the CO_2 into the closed system. The chamber, 25.5 cm in diameter and 31 cm high, was settled on circular collars installed in the field at a depth of 3-5 cm into the soil. The use of collars reduces the disturbance effects caused by inserting the chamber directly into the soil. Collars were installed at least 6 hours before making measurements; one collar was installed for each treatment.

Due to uncertainties on possible sampling contamination by backwater flow from the drainage ditch in front of the experimental units, the following discussion on this component was based on two sample events collected in 2006 (February 14 and 27) and four sample events in 2007 (February 13, March 15, April 11 and 26) for a total of six rain events. However, complete details during the 2006-2007 sampling period are available in the appendix.

4.3. Results and Discussion

Figures 4.1 displays the runoff flow measured from the sugarcane field under different residue management treatments during independent rain events in 2006. In general, runoff water increased in those treatments where sugarcane was reduced or removed from the field;

i.e. ground burning (GB), or sugarcane residue particles size was reduce as in the case of the shredded material (SM). It was observed that shredding the residue blanket allowed the runoff to remove the residue more easily, leaving the soil exposed to the effect of subsequence rainfall and runoff water. Burning the residue blanket may also increase the potential for runoff and sediment transportation into water bodies.

Conservation tillage practices may have an important impact on reducing the erosion of sediments by reducing runoff. Nitrogen, phosphorus and pesticides losses would likely be reduced by conservation tillage practices under any cropping system (Mikkelson et al. 1994). Figure 4.2 displays the nutrients loading for different water quality parameters measured in the rain event of February 27th 2006. Nitrogen loading is consistent with earlier finding reported by Bengtson et al. (2007); indicating that the average annual nitrogen loss in a burned sugarcane field varied between 8.1 and 28.8 kg ha^{-1} during 2002 to 2005 sampling period. Total dissolved and suspended solids are major pollutant by volume of surface water in Louisiana. It can cause a significant impairment in water quality by reducing light penetration, photosynthesis, aquatic life, and oxygen relationships (Houslow, 1995).

Table 4.1 displays total dissolved solids, total suspended solids, nitrate, and phosphate for each treatment during the 2006 sampling period. The analytical results show differentiated behaviors for each treatment at each rain event. Total suspended solids were similar for most of the treatments.

In the event recorded in February 14th, total suspended solids (TSS) were higher in treatments where soil coverage was removed, as in the case of open field burning, and shredder material (93.4 mg L^{-1} and 104.3 mg L^{-1} respectively). In the case of compost tea + stabilized urea, higher concentrations may be explained by the addition of mineral nitrogen.

The findings may indicate that treatments where soil coverage was removed from the soil may produce larger loads of pollutants, especially during higher precipitation events.

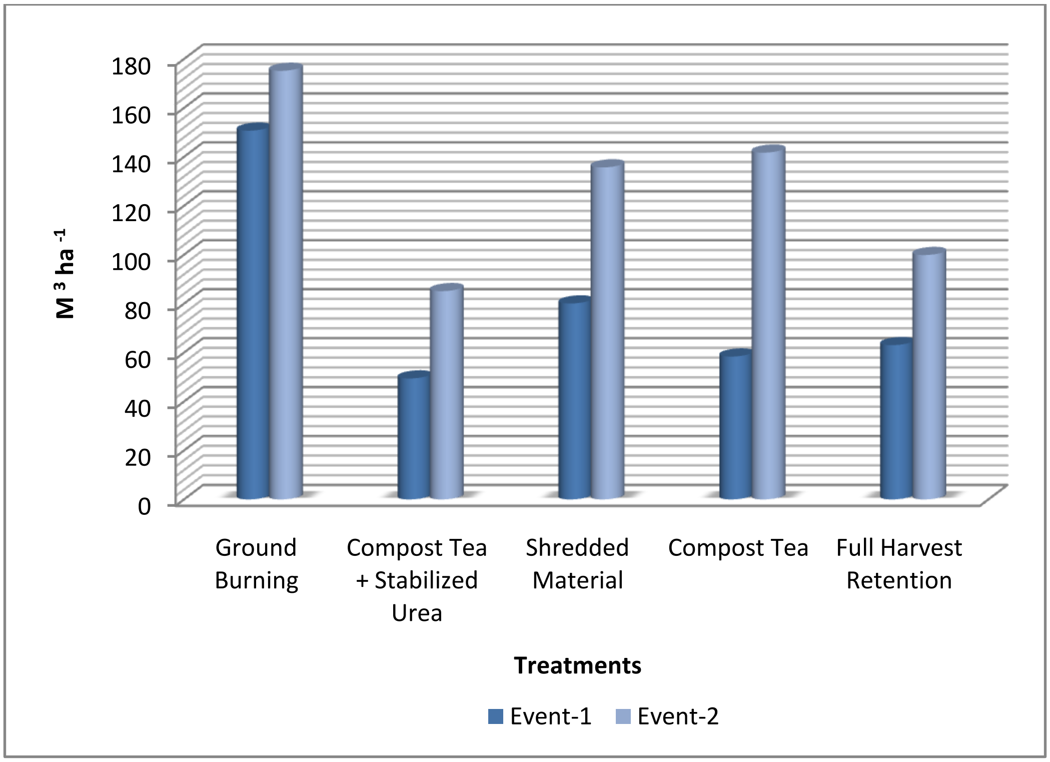
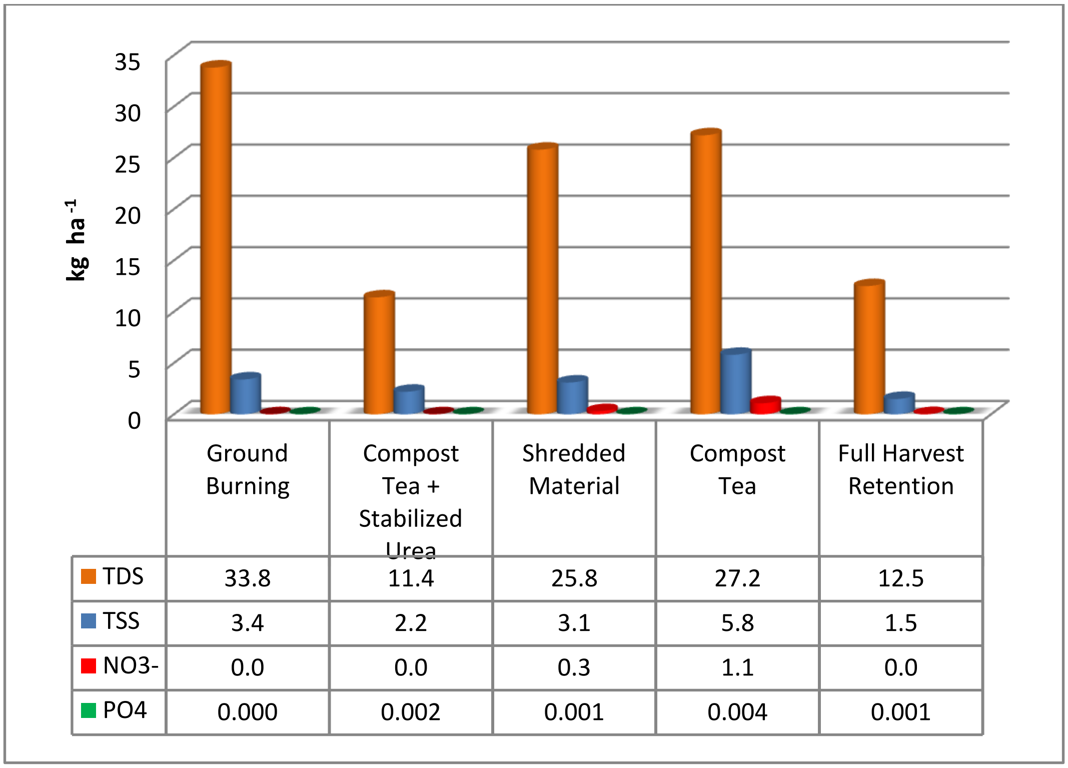


Figure 4.1 Runoff water volumes, from sugarcane field under different sugarcane residue management treatments. Youngsville, LA (February 2006).

Concentrations of NO_3^- show higher values for compost tea and compost tea + stabilized urea. This pattern may be explained by considering microorganism activity in the compost tea and mineral nitrogen application in nitrogen-urea. The concentration of PO_4 increased when soil coverage was removed from soil like in the case of ground burning and shredded material. Annual load of each ion will react to the flow for any rain event.

Table 4.2 and 4.3 display the water quality parameters measured during the 2007 sampling period. Concentrations of measured ions vary similarly to those in 2006. Total dissolved and suspended solids during the event measured in April may be correlated to agronomic practices to prepare sugarcane field.



	Ground Burning	Compost Tea + Stabilized Urea	Shredded Material	Compost Tea	Full Harvest Retention
TDS	33.8	11.4	25.8	27.2	12.5
TSS	3.4	2.2	3.1	5.8	1.5
NO3-	0.0	0.0	0.3	1.1	0.0
PO4	0.000	0.002	0.001	0.004	0.001

Figure 4.2 Sediments and nutrients loss form sugarcane field under different sugarcane residue management treatments. Youngsville, LA (February 2006).

The NO_3^- concentration showed the same behavior compared to samples measured in 2006. Nitrate concentration in runoff water was higher in treatments where microorganisms likely helped to stimulate nitrogen transformations; i.e. compost tea and compost tea + stabilized urea. Concentrations up to 0.37 mg L^{-1} and 5.16 mg L^{-1} of nitrate nitrogen were measured for compost tea and compost tea +stabilized urea respectively. It may be assumed that the nitrate concentration gives a good estimate of the mineralization of soil organic matter and that this mineralized N was rapidly nitrified. In addition, applications of biological compost tea and slow release nitrogen fertilizer could enhance weeds growth and nitrogen transport to water bodies.

Table 4.1 Water quality parameters from sugarcane fields under different residue management practices. Youngsville, LA. January 2006 to May 2007.

Treatments	Water Quality Parameter							
	TDS, mg l^{-1}		TSS, mg l^{-1}		NO_3^-, mg l^{-1}		PO_4, mg l^{-1}	
	2/14/2006	2/27/2006	2/14/2006	2/27/2006	2/14/2006	2/27/2006	2/14/2006	2/27/2006
Ground Burning	232.0	193.2	93.4	19.3	0.20	0.09	0.05	ND
Compost Tea + Stabilized Urea	293.7	134.3	241.6	25.5	9.95	0.12	0.12	0.02
Shredded Material	162.2	190.3	104.3	22.2	0.28	2.30	0.09	0.01
Compost Tea	240.0	192.2	65.4	40.8	0.18	7.63	0.04	0.03
Full Harvest Retention	202.0	125.2	82.1	14.7	0.25	0.16	0.03	0.01

Nonetheless, it may indicate the opportunity to reduce supplemental nitrogen to sugarcane fields. Increments in biochemical oxygen demand may be a consequence of microorganism activities which may increase the dissolved oxygen demand in receiving waters.

The analysis of variance showed that treatments were similar in their effect on measured water quality parameters. Duncan’s grouping confirmed that all treatments were not statistically significant (alpha= 0.05).

A paired t-test conducted to individual and average concentrations indicate that variability may affect the significance of the test. However, it is important to point out that treatments produced an effect on the average concentration of each water quality parameter evaluated in the field.

Table 4.2 Total dissolved and suspended solids concentrations from sugarcane fields under different residue management practices. Youngsville, LA. January to May 2007.

Water Quality Parameters	Water Quality Parameter							
	Total suspended solids, mg l^{-1}				Total dissolved solids, mg l^{-1}			
	2/13/2007	3/15/2007	4/11/2007	4/26/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007
Ground Burning	3569.8	268.2	878.0	6988.7	351.7	133.3	1053.3	1020.0
Compost Tea + Stabilized Urea	1674.3	0.0	221.0	5891.8	578.3	0.0	1013.3	1229.2
Shredded Material	2853.3	144.0	785.1	7633.5	627.5	113.3	950.8	1002.5
Compost Tea	453.4	1579.2	843.3	5504.9	225.0	132.5	1036.7	987.5
Full Harvest Retention	1502.6	140.3	694.8	6594.0	368.3	123.3	905.0	1069.2

Table 4.4 summarizes the data for soil carbon dioxide fluxes for selected sugarcane residue treatments during 2006 and 2007 experimental period. Average CO_2 fluxes (µmol m^2 s^{-1}) are characterized by an increase from early measurement in the spring compared to higher fluxes at the end of the spring.

The data supports earlier findings that production of CO_2 in soil is mainly affected by temperature and moisture conditions. The findings suggest that microbiological populations in the compost tea may indicate that post harvest compost tea application may have a positive effect on soil-CO_2 fluxes as an indication of organic matter degradation

Table 4.3 Nitrate and Phosphorus concentrations from sugarcane fields under different residue management practices. Youngsville, LA. January to May 2007.

Treatments	Nitrate, mg l^{-1}				Total phosphorus, mg l^{-1}			
	2/13/2007	3/15/2007	4/11/2007	4/26/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007
Ground Burning	0.05	0.08	2.13	0.32	1.22	0.24	1.75	6.93
Compost Tea + Stabilized Urea	0.08	0.00	5.16	1.34	0.62	0.00	0.95	5.61
Shredded Material	0.07	0.03	2.28	0.29	0.86	0.13	1.14	6.45
Compost Tea	0.16	0.37	0.26	0.33	0.44	0.23	1.58	5.67
Full Harvest Retention	0.15	0.26	0.15	0.32	0.63	0.13	NS	5.97

The results obtained during the two-year sampling period show that spraying compost tea to postharvest residue in the field rather than burning may enhance trash-mat degradation. Although, this practice may benefit water and air quality parameters, the practice could reduce sugarcane yield (Richard, 2001).

Table 4.5 displays the means separation conducted to yield-data from two subsequence years (2006 and 2007). For 2006 there is a significant statistically difference (alpha =0.05) among treatments. Compost tea application performed better compared to others treatments including the traditional open field burning.

Yield-data for the subsequence year (2007) are not statistically different (alpha = 0.05). Yields were slightly less in the subsequence year which is consistent with previous research indicating that sugarcane residue left in the field by a combine-harvester may reduce sugarcane yields in subsequent crops, if it is not removed from the row or burned (Richard and Johnson, 2003).

Table 4.4 Soil carbon dioxide flux from sugarcane from sugarcane fields under different residue management practices. Youngsville, LA. 2006-2007.

Water Quality Parameters	**Soil Carbon Dioxide Flux, µmol m^{-2} s^{-1}**							
	2/15/2006		3/1/2006		3/15/2007		3/28/2007	
	CO_2-flux	T°C	CO_2-flux	T°C	CO_2-flux	T°C	CO_2-flux	T°C
Full Harvest Retention	0.7	16.0	1.3	17.9	3.4	23.8	1.5	18.8
Ground Burning	2.4	18.7	2.8	20.1	3.2	23.9	1.0	21.7
Compost Tea + Stabilized Urea	1.0	15.1	1.2	17.2	2.7	23.6	1.5	18.4
Shredded Material	2.5	16.5	3.6	19.0	3.8	23.9	2.0	20.1
Compost Tea	1.6	16.5	2.1	18.9	4.3	24.1	1.6	19.5

Table 4.5 Sugarcane yields from fields under different residue management practices. Youngsville, LA. 2006 - 2007.

Treatments	**Crop Yield**	
	Yield stubble, kg ha^{-1}	
	2006	2007
Ground Burning	64,444 ba	63,321 a
Compost Tea + Stabilized Urea	54,564 c	53,441 a
Shredded Material	59,280 bc	53,441 a
Compost Tea	71,630 a	57,034 a
Full Harvest Retention	59,729 bc	58,381 a

Treatments with same letters are not significant (alpha=0.05)

Additionally, crop losses for the subsequent crop may reach up to 25% if residue is allowed on the row top until spring (Sugarcane BMP's, 2000). The results indicate that sugarcane yield from burning and full harvest retention treatments decreased 2% in 2007 compared to 20% for compost tea. However, similar research conducted at Jeanerette Louisiana indicates that subsequent yield was not significantly affected by leaving sugarcane residue in the field. It seems that long-term data will be required to characterize the benefits of a residue-management program, with a subsequent positive impact on the environment by reducing nutrient and pesticides losses through runoff and erosion.

4.4. Conclusions

A decrease in quality of water has been accompanied by an increase in chemical fertilization; this fact has been cited as a proof that fertilizer usage is related to the increased nutrient supply for surface water. There is a consensus that the majority of the total phosphorus load to water bodies results from land runoff. Sediment is a major pollutant by volume of surface water in Louisiana. It can cause an important impair in water quality, by reducing light penetration, photosynthesis, aquatic life, and oxygen relationships. The results suggest that sugarcane residue management left in the field at least under this conditions, may reduce nutrients transportation by runoff water, especially nitrogen and phosphorus compounds present in fertilizers, which are involved in the process of eutrophication of water bodies. The findings indicate that applications of biological compost tea and slow release nitrogen fertilizer could enhance nitrogen transport to water bodies. It also may indicate the opportunity to reduce supplemental inorganic nitrogen to sugarcane fields. The results partially support previous research indicating that the combine-harvester leaves a green-chopped residue blanket on the soil, which may reduce sugar yields in subsequent crops; since sugarcane residue management treatments were not significantly different (alpha = 0.05) with respect to yield during 2006 and 2007 subsequence harvest periods.

Furthermore, burning the residue led to higher runoff water (175.2 m^3 ha^{-1}), high concentrations of suspended solids (93.4 mg L^{-1}), and subsequence high concentrations of phosphate (0.05 mg L^{-1}) for a single event. In a single rain event for 2007; ground burning and shredded material showed concentrations of 6.93 mg L^{-1} and 6.45 mg L^{-1} of phosphate in runoff water. According to EPA phosphorus concentrations may not exceed 0.1 mg L^{-1} in flowing waters that do not discharge directly into lakes or impoundments to avoid eutrophication (U.S. Geological Survey, 1995).

CHAPTER 5

DESIGN AND TESTING OF AN INEXPENSIVE WATER CAPTURE DEVICE FOR WATER QUALITY ASSESSMENT

5.1. Introduction

The term water quality is not a new concept; however, it may have different meanings for an aquatic scientist concerned with aquatic life, a farmer concerned with irrigation, or public health officials concerned with the protection of human health. Water quality should be related to the anticipated beneficial use of water for things, like fish and wildlife protection, drinking water, or agriculture (Krenkel, 1980). Also, water should be managed so that no use at one location will be detrimental to its use at another location. Any addition of something to the water, which changes its natural state to where the downstream user cannot have all beneficial uses may be considered as pollution.

Growing interest in water quality has resulted in the development of monitoring programs and intensive sampling for various water quality parameters. Common purposes are regulatory, sources, and nutrient transportation (Wossenu, et.al. 1997). The Clean Water Act (CWA) and other regulations have positively impacted the reduction of point source pollutants. However, non-point sources (NPS) are considered a main cause of eutrophication in the United States, resulting in water bodies' impairment. The current regulatory trend of Total Maximum Daily Loads (TMDL) has moved the focus from point sources control to non-point source pollution assessments (U.S. EPA. 1998). The complexity of water quality is reflected by the many types of biological, chemical, and physical parameters measured. Simple measurements are those that can be made with an instrument in the field. However, more complex, or difficult, parameters require analytical methods to be conducted in a laboratory. As a result, samples may be collected from the field and later analyzed in a laboratory. Sampling is the process of gathering information with the least cost and least error; and it may require expensive equipment to collect, preserve, and afterward analyze samples. In-situ measurements of sediment and nutrients in runoff from farm fields is an increasing issue because of the need to characterize practices, which conserve soil and water resources and promote environmental harmony. Many instruments have been developed to measure runoff and nutrients losses from agricultural fields; i.e. tanks, flumes, slot divisors, automated systems. Total collection tanks must be large enough to collect water from small and representative experimental units during a maximum rain event (Bonilla et al., 2006). Automated water samplers are easy to install and program, and can store water samples through a storm event. Besides, automated water samplers are easily moved from site to site. However, automated instrumentation may be relatively expensive.

The primary purpose of this paper is to present a practical, secure, economical, and reliable system to collect water samples in situ. The system is a modest low-cost technology to manually collect composite water-samples from agricultural field runoff.

5.2. System Description and Installation

The system was designed to measure and collect runoff water from agricultural fields. There are different components included:

5.2.1. The Collectors

The runoff water was conveyed into a buried barrel (Figure 5.1a) by installing a heavy duty rubber pond-liner at the end of the furrows (figure 5.1b-c), which routed the runoff into the first collector. This prevented infiltration losses, avoided undesired soil transport, as well as permitted a smooth transition between the evaluated plot and the bare soil surrounding the collector. The pond-liner was fastened to the soil by using plastic clamps to avoid removal by wind or water flow. The collectors were three 200 liter (55 gallon) open-head poly drums, lightweight, durable and rust proof.

Figure 5.1a. 200 liter poly barrel being buried near surface level.

Figure 5.1b. Heavy-duty pond liner.

Figure 5.1c. Heavy-duty pond liner installation.

The first barrel was buried in the center at the end of the furrows used for water collection. It was located underneath the pond liner. When installing the first barrel, it was important to consider the effect of buoyancy in the disturbed soil to avoid possible removal.

Compact the soil surrounding the barrel, and/or providing support for the barrel helped stabilize it. The level of the first barrel had to be lower than the level of the furrow bed. A plastic liner was installed in each barrel to facilitate water sampling and collector cleaning (Figure 5.2a-b).

Also a flexible 9mm (3/8 “) nominal i.d. PVC tube was installed inside the barrel to fasten the plastic liner and prevent inward force which might push the liner inward (Figure 5.2b). A 0.2 kilowatts sump pumps (Figure 5.3a-b), capable of 8.6 m^3 hr^{-1} with a head of 1.5 m, were installed inside each of the first two barrels to pump water out and control the column of water (height).

Figure 5.2a. Barrel liner and with retaining hoop.

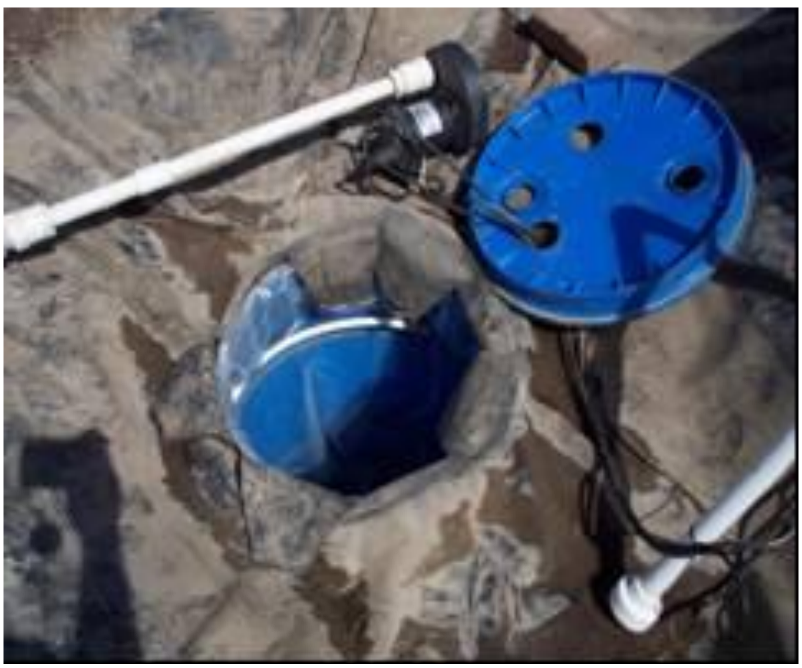


Figure 5.2b. Barrel's liner and retaining hoop inside barrel, with liner shown allowing water to enter around edges of barrel.

The sump pump was able to drain a rainfall of 25 mm hr^{-1} from a 120 square meter plot. The sump pump was equipped with a float switch to control the column of water (height) inside the first and second barrel. When the desired column of water was reached in the barrel the pump was activated and water was pumped out to a second barrel, connected by a 25 mm PVC pipe. A set of two valves (25 mm nominal i.d.), previously calibrated, allowed approximately 10% of the total runoff into the second barrel, while 90% was discarded into the drain system.

Figure 5.3a. Sump pump with float and plumbing before installation.

Split flow measurements have been made in the past (Abtew et al., 1997), and the technique was fairly well proven. In this case, it also allowed for a relatively low cost and repeatable technique. The process was repeated for the second barrel, 10% of the flow discharged in the second barrel was routed to the third barrel and 90% of this water was discarded to the drain system. This water was then pumped out to a third barrel, which had an overflow valve for extremely large rain events and also went to the drainage system (Figure 5.4). Valve calibration was important to assure the precision of the volume routed into the barrels.

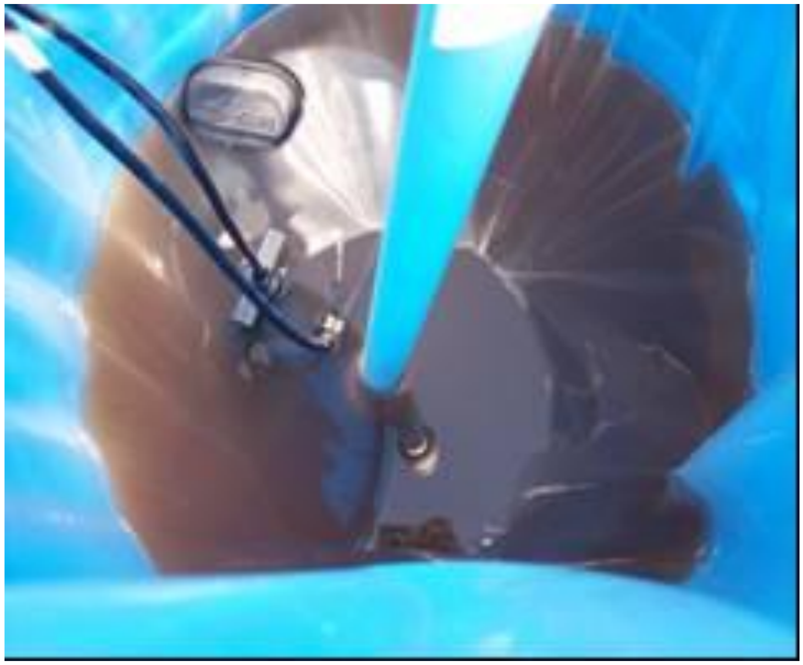


Figure 5.3b. Sump pump inside in-ground barrel.

The water stored in each barrel was used to measure simple parameters including pH, electrical conductivity, dissolved oxygen, and nutrients. The water in the third barrel represented a composite sample that was intended to be collected in a maximum elapsed time of 24 hours after the rain event. This was then to be later analyzed in the laboratory for the desired water quality parameters; i.e. biochemical oxygen demand, chemical oxygen demand, nitrates, phosphates, total solids, etc. Additionally, a sensor to measure temperature (i.e. a thermocouple); could be installed in each barrel to establish a potential correlation with biological parameters as dissolved oxygen. The use of PVC unions allowed rapid disconnection when cleaning the system.

5.2.2. The Power Supply

The power supply for the pump was provided by two-12 volt direct current (DC), deep cycle batteries connected to a 2000-watt Chicago Electric Power Systems DC-AC inverter that converted 12V (DC) into 120V alternating current (AC).

Figure 5.4. Split flow system installed in field.

Figure 5.5 Power supply included two 12-V DC batteries and a 2000W inverter.

Batteries were connected to the inverter by using a minimum 4-gauge wire. The inverter was equipped with a program that protected the battery and avoided operation with a voltage lower than 10 volts. This same system created a local audible warning at 11 volts. In some cases, solar panels were used to provide continuous energy to the batteries.

A 90 amp-hour deep cycle battery may operate the pump for at least 6 hours. Batteries and inverters were located in lightweight, durable and rust-proof boxes. The use of DC pumps is recommended to simplify the connections.

5.2.3. Flow Splitters

The amount of runoff water collected in each barrel was determined by the opening of globe-valves, in direct proportion to the pump capacity. This was based on flow continuity and its relationship to the cross section of a pipe. Then globe-valves were calibrated accordingly to the percentage of flow required as samples. Preliminary calculations were required to calibrate flow ratio with an acceptable error of $\pm 2\%$. The present study set up a ratio of 10:90 which means that 10 % of the total runoff flow was captured in each barrel and 90% was discharged into the drainage system. Figure 5.7a-b display a pair of 25 mm globe-valves used to split flow.

5.3. Runoff Volume Calculation

The volume of runoff was determined by measuring the depth of water remaining in each barrel, and considering the volume discharged to the drainage system. Equations (1) and (2) describe the calculation for any barrel size, based on 90% runoff deviated to the drainage system and 10% of runoff captured for sampling; for two and three barrels respectively.

$$V = (\pi r^2 h_1) + 10(\pi r^2 h_2) \tag{1}$$

$$V = (\pi r^2 h_1) + 10(\pi r^2 h_2) + 100(\pi r^2 h_3) \tag{2}$$

Where V represents the total volume (m^3), r (m) the radius of the barrel, and h (m) represents the height of water inside each barrel.

Figure 5.6. The water sampler as installed.

Figure 5.7a Globe-valves to split flow into 90/10% (Closed view).

Figure 5.7b Globe-valves to split flow into 90/10%.

If the system is used to evaluate research treatments upstream of the catchment's area, a dilution factor may be calculated to account for the amount of rainfall directly affecting the volume of water collected. The installation of a heavy duty tarp as a roof may also help this inaccuracy when calculating concentrations of required water quality parameters.

Table 5.1 displays analytical results of runoff water collected by using the water capture device. The system complied with accurate analytical procedure to evaluate water quality dynamics in open field conditions.

5.4. System Cost

This runoff water sampler cost represented approximately one-tenth of regular automated water samples, which makes the system appropriate for some small projects. It was time consuming for routine and/or large sampling programs, and demands a significant amount of labor.   Such a system would be appropriate for use in areas where labor costs are relatively low compared to equipment costs. Possible examples include farm situations where only occasional sampling is required, or possibly countries or areas where labor is readily available and costs are low.

The system was built with parts easily acquired at local hardware and electrical supply stores. Table 5.2 displays part list, quantities and prices to build one complete system.

Table 5.1 Use of the water capture device to assess water quality under different residue management practices. Youngsville, LA. February 2006.

Treatments	Water Quality Parameter									
	TDS, mg -l		**TSS, mg -l**		**NO_3^-, mg -l**		**PO_4, mg -l**		**Runoff, m^3 ha $^{-1}$**	
	2/14/2006	2/27/2006	2/14/2006	2/27/2006	2/14/2006	2/27/2006	2/14/2006	2/27/2006	2/14/2006	2/27/2006
Ground Burning	232	193.2	93.4	19.3	0.2	0.09	0.05	ND	150.7	175.2
Compost Tea + Stabilized Urea	293.7	134.3	241.6	25.5	9.95	0.12	0.12	0.02	49.4	85.1
Shredded Material	162.2	190.3	104.3	22.2	0.28	2.3	0.09	0.01	80.1	135.7
Compost Tea	240	192.2	65.4	40.8	0.18	7.63	0.04	0.03	58.4	141.7
Full Harvest Retention	202	125.2	82.1	14.7	0.25	0.16	0.03	0.01	63.1	99.9

Table 5.2 Materials and instrumentation required to install the water sampler.

Item	Quantity	Units	Unit Price$	Total, $
Barrels, 55 gallons, open head	3	Units	45	135
Pond Liner, heavy duty	10	Feet	13	130
Sump pump, ¼ HP;	2	Units	85	170
Barrel’s liners	3	Units	3	9
PVC pipe, 1 inch, schedule 40	18	Feet	2	36
PVC, connector	4	Units	3	12
PVC-globe-valves, 1 inch	4	Units	4.5	18
PVC-T’s, 1 inch	2	Units	0.85	1.7
PVC-codes, 90 o; 1 inch	4	Units	0.6	2.4
PVC-cement	1	Unit	3.75	3.75
Battery, 90 –amps, deep cycle	2	Units	70	140
Battery cables, 2-gauge	4	Units	5	20
Inverter, 2000 watts	1	Units	150	150
Plastic box, rust proof	1	Unit	10	10
Clamps	2	Units	1	2
			Sub-total	**$ 839.8**

* The budget does not include the cost of labor and additional equipment like: solar panel, data logger, which may be acquired upon specific needs.

5.5. Conclusions

A low cost system for automatically capturing composite water quality samples was built. The cost was approximately one order of magnitude lower than standard automated water capture devices and the functionality was acceptable. Water quality samples and blanks captured with this device appear similar to those captured with manufactured sampling devices. However, labor for capturing large numbers of these samples, and energy requirements, appear greater. This suggests these systems may be appropriate in areas where labor is inexpensive, such as developing countries, or in areas where small numbers of samples are needed.

GENERAL CONCLUSIONS

An effective residue-management program must result in a high percentage of green harvested sugarcane, with a subsequent positive impact on the environment by reducing nutrient and pesticides losses through runoff and erosion. This research has taken a step in the direction of developing new methods for assessing alternative sugarcane residue management to accelerate organic matter degradation. Our preliminary studies, reported that carbon dioxide evolution rates (mg CO_2-C gr^{-1}DW h^{-1}) were increased when applying compost tea to shredded and non-shredded material under laboratory conditions; whereas no significant differences were found among “in-lab” treatments. On the other hand, open field degradation and water quality dynamics were positively affected by different sugarcane residue management treatments. The results report that soil carbon dioxide fluxes (μmol m^2 s^{-1}) as an indication of organic matter degradation were significantly increased when applying compost tea to sugarcane residue left in the field. The most practical degradation rate may be achieved when applying a dosage of 2.8 m^{3} $hectare^{-1}$ two times during the spring-time. The present research also demonstrates that compost water-extracts also known as compost tea increases the degradation rate of organic residue and it could lead to further research to understand and model the use of this novel technology in our effort to provide an environmental technology according to the regulations adopted by the Environmental Protection Agency (EPA).

The results obtained during the two-year sampling period show that spraying compost tea on postharvest residue in the field rather than burning may enhance trash-mat degradation and may favor long-term soil sustainability by positively affecting physical and chemical characteristics and by degrading many agrochemicals which may represent a potential threat to natural ecosystems. Although this practice may benefit water and air quality parameters, the practice could reduce sugarcane yield and an effective practice is needed.

RECOMMENDATIONS

Nitrogen and phosphorus over-fertilization, and pesticide runoff are identified as major non-point source pollutants causing water quality impairment. N and P are not directly linked to sugarcane crop management. However, the clean water act section 303 (d) requires that the State review water quality standards at least once every three years. A regulatory instrument such as TMDLs are reviewed, the direct relationship between sugarcane fields, management practices and non-point sources of pollution will be established. Further research will be required to determine if the effects of compost tea and full harvest retention of the "trash-mat" would be the same under different soil, cane varieties, fertilizer application, and environmental conditions to eliminate the need to burn the combine-residue blanket. Additional research must be focused on methods to assess and potentially reduce water quality issues in sugarcane; improving the sustainability of sugarcane farming through profitable and environmentally acceptable approaches.

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APPENDIX A

SAMPLE-DATA 2006

This appendix contains the data for samples collected during 2006. Water quality parameters are indicated for each treatment and averages were calculated based on two replications when available. A summary for each treatment is also shown in this section.

Location: Youngsville, Louisiana
Sampling date: 2/13/2006
Rain event:

Water Quality Parameters	Treatments																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	I	II	Stdev	Avrg	I	II	Stdev	Avrg	I	II	Stdev	Avrg	I	II	Stdev	Avrg	I	II	Stdev	Avrg
Total dissolved solids, mg/l	226.0	238.0	8.5	232.0	326.7	260.7	46.7	293.7	165.8	158.7	5.1	162.2	262.7	217.3	32.1	240.0	256.0	148.0	76.4	202.0
Total suspended solids, mg/l	143.0	43.7	70.2	93.4	122.0	361.2	169.1	241.6	51.0	157.6	75.4	104.3	27.8	103.1	53.2	65.4	125.9	38.2	62.0	82.1
Turbidity, NTU	344.7	137.3	146.6	241.0	244.3	259.0	10.4	251.7	290.7	211.3	56.1	251.0	64.9	95.0	21.3	79.9	274.3	110.7	115.7	192.5
Biochemical oxygen demand, mg/l	7.0	8.8	1.3	7.9	5.7	12.2	4.6	9.0	5.10	6.00	0.6	5.6	13.00	10.70	1.6	11.9	8.20	6.30	1.3	7.3
Total Khejdal nitrogen, mg/l	0.4	0.4	0.1	0.4	ND	0.2	ND	0.2	1.24	0.22	0.7	0.7	0.26	0.26	0.0	0.3	0.18	0.35	0.1	0.3
Total phosphorus, mg/l	0.1	0.0	0.0	0.0	0.2	0.1	0.1	0.1	0.089	ND	ND	0.1	0.054	0.030	0.0	0.0	ND	0.027	ND	0.0
Nitrite, mg/l	ND	ND	ND	ND	1.1	0.4	0.5	0.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate, mg/l	0.3	0.1	0.1	0.2	14.1	5.9	5.8	10.0	0.30	0.25	0.0	0.3	0.25	0.10	0.1	0.2	0.25	0.25	0.0	0.3
Chloride, mg/l	12.1	14.4	1.6	13.3	12.7	13.6	0.6	13.2	10.50	9.55	0.7	10.0	15.20	14.22	0.7	14.7	11.62	9.70	1.4	10.7
Bromide, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sulfate, mg/l	3.5	4.1	0.4	3.8	3.4	3.0	0.3	3.2	2.84	2.77	0.0	2.8	2.56	2.16	0.3	2.4	2.95	2.83	0.1	2.9

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 2/27/2006

Water Quality Parameters	Treatments																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	218.3	168.0	35.6	193.2	115.3	153.3	26.9	134.3	196.0	184.7	8.0	190.3	150.7	233.7	58.7	192.2	112.7	137.7	17.7	125.2
Total suspended solids, mg/l	22.5	16.0	4.6	19.3	15.2	35.7	14.5	25.5	22.5	22.0	0.3	22.2	38.1	43.6	3.9	40.8	11.4	17.9	4.6	14.7
Turbidity, NTU	36.3	43.3	4.9	39.8	32.1	36.0	2.8	34.1	37.4	41.1	2.7	39.3	96.2	70.7	18.0	83.4	20.7	22.4	1.2	21.6
Biochemical oxygen demand, mg/l	12.00	8.30	2.6	10.2	9.90	7.00	2.1	8.5	16.80	10.40	4.5	13.6	7.20	7.40	0.1	7.3	8.40	9.30	0.6	8.9
Total Khejdal nitrogen, mg/l	0.77	0.91	0.1	0.8	2.60	0.73	1.3	1.7	2.52	1.85	0.5	2.2	0.97	0.89	0.1	0.9	1.02	1.65	0.4	1.3
Total phosphorus, mg/l	ND	ND	ND	ND	ND	0.016	ND	0.0	0.015	ND	ND	0.0	0.048	0.016	0.0	0.0	0.013	ND	ND	0.0
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.53	ND	0.5	ND	ND	ND	ND
Nitrate, mg/l	0.05	0.12	0.0	0.1	0.06	0.18	0.1	0.1	0.05	4.55	3.2	2.3	0.12	15.14	10.6	7.6	0.22	0.10	0.1	0.2
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	17.68	16.13	1.1	16.9	13.15	12.37	0.6	12.8	15.90	13.18	1.9	14.5	12.87	14.64	1.3	13.8	11.42	10.69	0.5	11.1
Sulfate, mg/l	4.57	4.08	0.3	4.3	2.96	3.37	0.3	3.2	2.80	2.53	0.2	2.7	3.04	2.56	0.3	2.8	3.37	2.66	0.5	3.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Sampling date: 4/27/2007

Water Quality Parameters	Treatments														
	Ground burning			Stabilized urea+ Compost tea			Shredded material			Compost tea		Full harvest retention			
	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	R-I	R-II	Avg	
Total dissolved solids, mg/l	267.5		267.5	345.0		345.0	230.3	242.6	236.4			303.7		303.7	
Total suspended solids, mg/l	1544.5		1544.5	1138.3		1138.3	1846.5	1539.3	1692.9			853.3		853.3	
Turbidity, NTU	2189.0		2189.0	1831.5		1831.5	2404.0	1884.0	2144.0			1367.0		1367.0	
Biochemical oxygen demand, mg/l	16.9		16.9	22.9		22.9	13.7	16.8	15.3			13.0		13.0	
Total Khejdal nitrogen, mg/l	3.2		3.2	1.3		1.3	2.9	5.3	4.1			3.9		3.9	
Total phosphorus, mg/l	0.3		0.3	0.3		0.3	0.4	0.3	0.4			0.3		0.3	
Nitrite, mg/l	ND		ND	ND		ND	ND	ND	ND			ND		ND	
Nitrate, mg/l	1.1		1.1	0.7		0.7	0.8	1.0	0.9			1.2		1.2	
Chloride, mg/l	10.8		10.8	6.7		6.7	11.4	14.3	12.9			9.5		9.5	
Bromide, mg/l	ND		ND	ND		ND	ND	ND	ND			ND		ND	
Sulfate, mg/l	3.7		3.7	3.4		3.4	3.8	3.7	3.8			3.8		3.8	

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 5/1/2006
Rain event:

Water Quality Parameters	Treatments																	
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention	
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	Avg
Total dissolved solids, mg/l	595.0	620.0	17.7	607.5	510.0	720.0	148.5	615.0	460.0	580.0	84.9	520.0	635.0	660.0	17.7	647.5	695.0	695.0
Total suspended solids, mg/l	6450.5	9259.5	1986.3	7855.0	7021.5	6497.0	370.9	6759.3	6791.5	8624.0	1295.8	7707.8	6011.0	8288.5	1610.4	7149.8	6177.5	6177.5
Turbidity, NTU	6370	8946	1821.5	7658.0	7109	6356	532.1	6732.3	6696	7145	318.0	6920.4	5898	6991	773.4	6444.4	6545	6545.0
Biochemical oxygen demand, mg/l	8.58	8.46	0.1	8.5	7.98	8.28	0.2	8.1	9.06	9.48	0.3	9.3	10.26	9.48	0.6	9.9	10.02	10.0
Total Khejdal nitrogen, mg/l	3.46	6.40	2.1	4.9	4.91	4.08	0.6	4.5	7.47	4.05	2.4	5.8	13.56	7.84	4.0	10.7	8.77	8.8
Total phosphorus, mg/l	0.047	0.547	0.4	0.3	0.571	0.659	0.1	0.6	0.690	0.698	0.0	0.7	0.498	0.601	0.1	0.5	0.039	0.0
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate, mg/l	0.53	0.93	0.3	0.7	1.98	0.94	0.7	1.5	0.7	0.54	0.1	0.6	0.53	0.52	0.0	0.5	0.63	0.6
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	9.08	9.26	0.1	9.2	12.58	9.05	2.5	10.8	10.31	12.06	1.2	11.2	11.41	9.18	1.6	10.3	9.59	9.6
Sulfate, mg/l	3.25	3.90	0.5	3.6	3.75	3.64	0.1	3.7	3.78	4.00	0.2	3.9	3.29	3.23	0.0	3.3	3.72	3.7

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 5/8/2006

Water Quality Parameters	**Treatments**																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	197.5	185.0	8.8	191.3	270.0	205.0	46.0	237.5	207.5	195.0	8.8	201.2	175.0	222.5	33.6	198.8	227.5	220.0	5.3	223.8
Total suspended solids, mg/l	3813.3	6258.8	1729.2	5036.0	5112.3	3356.0	1241.9	4234.1	4941.3	6024.5	766.0	5482.9	3531.3	2253.3	903.7	2892.3	2185.8	3119.3	660.1	2652.5
Turbidity, NTU	3500.0	5148.5	1165.7	4324.3	5197.5	2817.5	1682.9	4007.5	5029.5	5216.8	132.4	5123.1	2709.0	1890.0	579.1	2299.5	2135.0	3083.5	670.7	2609.3
Biochemical oxygen demand, mg/l	3.7	7.2	2.5	5.4	8.1	6.1	1.4	7.1	8.9	10.3	1.0	9.6	8.2	5.6	1.8	6.9	4.9	4.2	0.5	4.5
Total Khejdal nitrogen, mg/l	2.3	3.7	1.0	3.0	8.6	2.7	4.1	5.6	5.1	4.3	0.6	4.7	2.0	1.3	0.5	1.7	2.5	2.4	0.0	2.5
Total phosphorus, mg/l	0.5	0.7	0.1	0.6	0.5	0.6	0.1	0.6	0.6	0.6	0.0	0.6	0.4	0.4	0.0	0.4	0.4	0.6	0.1	0.5
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate, mg/l	1.5	1.5	0.0	1.5	10.7	5.3	3.8	8.0	1.5	1.4	0.1	1.5	1.2	1.0	0.1	1.1	1.5	0.9	0.4	1.2
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	7.7	11.3	2.6	9.5	12.2	8.8	2.4	10.5	9.5	11.4	1.3	10.5	12.1	11.3	0.6	11.7	11.8	11.6	0.1	11.7
Sulfate, mg/l	3.7	4.9	0.9	4.3	2.8	3.5	0.5	3.2	3.9	4.6	0.5	4.3	4.5	5.1	0.5	4.8	4.2	5.0	0.6	4.6

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 7/10/2006
Rain event:

Water Quality Parameters	Treatments																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	140.0	300.0	113.1	220.0	357.5	235.0	86.6	296.2	45.0	220.0	123.7	132.5	315.0	285.0	21.2	300.0	122.5	120.0	1.8	121.2
Total suspended solids, mg/l	1371.0	3681.0	1633.4	2526.0	1508.5	1271.0	167.9	1389.8	1747.0	2100.5	250.0	1923.8	1058.5	495.8	397.9	777.1	582.8	332.9	176.7	457.8
Turbidity, NTU	1074.0	2674.0	1131.4	1874.0	1468.0	1010.0	323.9	1239.0	1392.0	1779.0	273.7	1585.5	861.0	493.0	260.2	677.0	488.0	592.0	73.5	540.0
Biochemical oxygen demand, mg/l	4.8	5.9	0.8	5.4	4.6	6.3	1.2	5.5	6.5	4.5	1.4	5.5	4.4	5.1	0.5	4.8	4.7	4.9	0.1	4.8
Total Khejdal nitrogen, mg/l	2.7	1.4	0.9	2.0	0.9	1.1	0.1	1.0	0.9	2.2	0.9	1.6	1.3	0.7	0.4	1.0	1.3	0.7	0.5	1.0
Total phosphorus, mg/l	0.1	0.3	0.2	0.2	0.0	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate, mg/l	0.2	0.3	0.0	0.2	1.2	0.9	0.3	1.0	0.3	0.4	0.1	0.3	0.3	0.3	0.0	0.3	0.2	0.4	0.1	0.3
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	3.4	3.2	0.1	3.3	3.6	3.4	0.1	3.5	3.2	3.6	0.2	3.4	4.3	3.7	0.5	4.0	3.7	3.3	0.3	3.5
Sulfate, mg/l	0.8	0.9	0.1	0.9	1.5	1.0	0.3	1.3	1.0	1.1	0.0	1.1	1.4	1.2	0.1	1.3	1.2	1.4	0.1	1.3

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 7/11/2006

Water Quality Parameters	**Treatments**																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	190.0	130.0	42.4	160.0	190.0	80.0	77.8	135.0	125.0	120.0	3.5	122.5	182.5	ND	ND	182.5	105.0	170.0	46.0	137.5
Total suspended solids, mg/l	896.0	1565.0	473.1	1230.5	839.0	671.0	118.8	755.0	993.0	1800.0	570.6	1396.5	673.8	ND	ND	673.8	572.0	524.0	33.9	548.0
Turbidity, NTU	838.0	1184.0	244.7	1011.0	800.0	535.0	187.4	667.5	893.0	1785.0	630.7	1339.0	494.0	0.7	348.8	247.4	325.0	569.0	172.5	447.0
Biochemical oxygen demand, mg/l	4.5	5.8	0.9	5.1	4.3	3.4	0.6	3.8	4.1	4.2	0.1	4.1	5.7	NR*	ND	5.7	6.2	4.0	1.6	5.1
Total Khejdal nitrogen, mg/l	0.7	1.4	0.5	1.0	0.9	0.6	0.2	0.8	0.5	0.9	0.3	0.7	0.4	0.7	0.2	0.5	0.7	2.0	1.0	1.3
Total phosphorus, mg/l	0.1	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0.1	ND	ND	0.1	ND	0.1	ND	0.1
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nitrate, mg/l	0.2	0.2	0.0	0.2	4.4	0.6	2.7	2.5	0.2	0.2	0.0	0.2	0.1	ND	ND	0.1	0.1	0.3	0.1	0.2
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	3.5	3.8	0.2	3.7	6.0	3.5	1.8	4.8	3.7	3.7	0.0	3.7	5.1	1.9	2.2	3.5	3.9	5.9	1.4	4.9
Sulfate, mg/l	1.0	1.0	0.0	1.0	1.7	1.1	0.5	1.4	1.2	1.1	0.0	1.2	1.8	ND	ND	1.8	1.4	1.3	0.0	1.4

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 7/17/2006

Water Quality Parameters	Treatments																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	63.3	503.3	311.1	283.3	173.3	53.3	84.9	113.3	180.0	160.0	14.1	170.0	143.3	190.0	33.0	166.7	226.7	145.0	57.7	185.8
Total suspended solids, mg/l	1396.3	994.3	284.3	1195.3	631.7	583.0	34.4	607.3	1001.0	2262.3	891.9	1631.7	717.3	225.0	348.1	471.2	320.7	378.7	41.0	349.7
Turbidity, NTU	720.0	597.0	87.0	658.5	526.5	324.0	143.2	425.3	599.0	1945.0	951.8	1272.0	444.0	199.5	172.9	321.8	224.0	311.0	61.5	267.5
Biochemical oxygen demand, mg/l	5.9	5.8	0.0	5.8	3.6	7.2	2.6	5.4	5.8	5.5	0.2	5.6	5.3	5.4	0.1	5.3	5.0	5.3	0.2	5.2
Total Khejdal nitrogen, mg/l	0.3	0.2	0.0	0.2	4.0	0.3	2.6	2.1	1.6	0.5	0.8	1.0	0.2	0.2	0.0	0.2	3.7	0.2	2.5	1.9
Total phosphorus, mg/l	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0	0.3	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrite, mg/l	0.3	0.3	0.0	0.3	ND	0.3	ND	0.3	0.3	0.3	0.0	0.3	0.3	0.3	0.0	0.3	0.3	ND	ND	0.3
Nitrate, mg/l	0.1	0.1	0.0	0.1	0.5	0.3	0.2	0.4	0.1	0.2	0.1	0.1	0.2	0.3	0.1	0.2	0.1	0.1	0.0	0.1
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	11.6	9.0	1.9	10.3	1.3	13.8	8.8	7.5	12.6	12.9	0.2	12.8	11.7	14.6	2.1	13.2	12.4	2.7	6.8	7.6
Sulfate, mg/l	1.4	1.1	0.2	1.2	1.0	1.2	0.1	1.1	1.0	1.3	0.2	1.2	1.9	1.4	0.3	1.7	1.3	1.4	0.0	1.3

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 7/24/2006

Water Quality Parameters	**Treatments**																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	183.3	50.0	94.3	116.7	50.0	150.0	70.7	100.0	13.3	90.0	54.2	51.7	110.0	25.0	60.1	67.5	113.3	96.7	11.8	105.0
Total suspended solids, mg/l	1005.7	857.3	104.9	931.5	605.5	622.0	11.7	613.8	1136.0	1113.3	16.0	1124.7	530.0	240.3	204.8	385.2	512.3	462.3	35.4	487.3
Turbidity, NTU	723.0	494.0	161.9	608.5	475.5	437.0	27.2	456.3	655.0	806.0	106.8	730.5	375.0	229.0	103.2	302.0	378.0	410.0	22.6	394.0
Biochemical oxygen demand, mg/l	4.6	5.9	1.0	5.2	6.7	5.4	0.9	6.1	6.3	4.7	1.1	5.5	5.4	4.1	0.9	4.8	5.1	5.0	0.1	5.1
Total Khejdal nitrogen, mg/l	0.6	0.3	0.2	0.5	1.3	0.4	0.7	0.9	0.9	0.5	0.3	0.7	2.0	0.7	0.9	1.4	1.0	1.6	0.4	1.3
Total phosphorus, mg/l	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrite, mg/l	0.3	0.3	0.0	0.3	ND	0.3	ND	0.3	0.3	0.3	0.0	0.3	0.4	0.3	0.0	0.4	0.3	0.3	0.0	0.3
Nitrate, mg/l	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.1	0.1	0.0	0.1
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	11.6	11.0	0.4	11.3	1.5	11.3	6.9	6.4	7.6	10.6	2.1	9.1	14.8	11.9	2.0	13.4	11.3	11.5	0.1	11.4
Sulfate, mg/l	1.3	1.3	0.0	1.3	1.1	1.3	0.2	1.2	1.1	1.3	0.2	1.2	2.1	1.4	0.5	1.7	1.8	1.3	0.4	1.5

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 8/17/2006

	Treatments																		
Water Quality Parameters	Ground burning			Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	86.7		86.7	110.0	93.3	11.8	101.7	83.3	63.3	14.1	73.3	ND	ND	ND	ND	93.3	86.7	4.7	90.0
Total suspended solids, mg/l	311.3		311.3	363.5	228.0	95.8	295.8	539.7	514.3	17.9	527.0	233.0	113.3	84.6	173.2	225.7	162.2	44.9	193.9
Turbidity, NTU	185.0		185.0	235.0	156.0	55.9	195.5	265.0	250.0	10.6	257.5	178.0	103.0	53.0	140.5	159.0	173.0	9.9	166.0
Biochemical oxygen demand, mg/l	5.6		5.6	NR	7.1	ND	7.1	6.8	7.3	0.4	7.0	5.7	6.2	0.4	5.9	8.3	5.9	1.7	7.1
Total Khejdal nitrogen, mg/l	0.2		0.2	0.2	0.2	0.0	0.2	0.3	0.3	0.1	0.3	1.0	0.3	0.5	0.6	0.2	0.2	0.0	0.2
Total phosphorus, mg/l	0.1		0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0	0.1
Nitrite, mg/l	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.2	ND	0.2
Nitrate, mg/l	0.3		0.3	0.3	0.2	0.0	0.2	0.2	0.2	0.0	0.2	0.4	0.2	0.1	0.3	0.3	0.3	0.0	0.3
Chloride, mg/l	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	6.6		6.6	3.0	8.9	4.2	5.9	5.1	4.4	0.5	4.8	21.6	5.9	11.0	13.8	4.7	6.7	1.4	5.7
Sulfate, mg/l	2.3		2.3	1.7	2.5	0.6	2.1	1.7	1.5	0.1	1.6	3.5	1.9	1.1	2.7	1.6	2.3	0.5	2.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 8/28/2006

Water Quality Parameters	Treatments: Ground burning			Stabilized urea+ Compost tea			Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	80.0		80.0	111.7		111.7	96.7	63.3	23.6	80.0	150.7	233.7	58.7	192.2	76.7	71.7	3.5	74.2
Total suspended solids, mg/l	546.0		546.0	629.0		629.0	655.0	346.7	218.0	500.8	38.1	43.6	3.9	40.8	500.0	221.0	197.3	360.5
Turbidity, NTU	318.0		318.0	487.5		487.5	286.0	302.0	11.3	294.0	96.2	70.7	18.0	83.4	239.0	168.0	50.2	203.5
Biochemical oxygen demand, mg/l	3.1		3.1	2.4		2.4	4.1	2.6	1.1	3.3	7.20	7.40	0.1	7.3	3.2	2.5	0.5	2.9
Total Khejdal nitrogen, mg/l	0.4		0.4	0.2		0.2	0.4	0.3	0.1	0.4	0.97	0.89	0.1	0.9	0.4	0.3	0.1	0.3
Total phosphorus, mg/l	0.1		0.1	0.1		0.1	0.1	0.1	0.0	0.1	0.048	0.016	0.0	0.0	0.1	0.1	0.0	0.1
Nitrite, mg/l	0.3		0.3	0.0		0.0	0.4	0.3	0.0	0.4	ND	0.53	ND	0.5	0.3	0.3	0.0	0.3
Nitrate, mg/l	0.2		0.2	0.2		0.2	0.2	0.2	0.0	0.2	0.12	15.14	10.6	7.6	0.3	0.1	0.1	0.2
Chloride, mg/l	ND		ND	ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	16.6		16.6	4.0		4.0	19.0	16.2	1.9	17.6	12.87	14.64	1.3	13.8	16.4	14.6	1.3	15.5
Sulfate, mg/l	1.5		1.5	1.1		1.1	1.5	1.5	0.1	1.5	3.04	2.56	0.3	2.8	1.5	1.5	0.0	1.5

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 9/25/2006

Water Quality Parameters	Treatments																
	Ground burning			Stabilized urea+ Compost tea				Shredded material			Compost tea				Full harvest retention		
	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Avg
Total dissolved solids, mg/l	33.3		33.3	30.0	23.3	4.7	26.7				13.3	70.0	40.1	41.7			
Total suspended solids, mg/l	291.7		291.7	195.0	207.3	8.7	201.2				258.0	214.0	31.1	236.0			
Turbidity, NTU	230.0		230.0	143.5	174.0	21.6	158.8				206.0	227.0	14.8	216.5			
Biochemical oxygen demand, mg/l	4.3		4.3	4.8	4.2	0.5	4.5				4.6	4.1	0.3	4.3			
Total Khejdal nitrogen, mg/l	0.2		0.2	0.6	0.2	0.3	0.4				7.7	2.2	3.9	4.9			
Total phosphorus, mg/l	0.5		0.5	0.6	0.6	0.0	0.6				0.7	0.9	0.2	0.8			
Nitrite, mg/l	0.3		0.3	ND	0.3	ND	0.3				0.1	0.3	0.1	0.2			
Nitrate, mg/l	0.3		0.3	0.3	0.4	0.1	0.3				0.5	0.3	0.1	0.4			
Chloride, mg/l	ND		ND	ND	ND	ND	ND				ND	ND	ND	ND			
Bromide, mg/l	6.3		6.3	6.3	8.4	1.5	7.3				6.3	6.3	0.0	6.3			
Sulfate, mg/l	1.5		1.5	1.9	2.4	0.4	2.1				1.5	1.7	0.1	1.6			

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	**Treatments**														
	Ground Burning/samples														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Total dissolved solids, mg/l	232.0	193.2	267.5	607.5	191.3	220.0	160.0	283.3	116.7	86.7	80.0	33.3	2471.4	607.5	33.3
Total suspended solids, mg/l	93.4	19.3	1544.5	7855.0	5036.0	2526.0	1230.5	1195.3	931.5	311.3	546.0	291.7	21580.4	7855.0	19.3
Turbidity, NTU	241.0	39.8	2189.0	7658.0	4324.3	1874.0	1011.0	658.5	608.5	185.0	318.0	230.0	19337.0	7658.0	39.8
Biochemical oxygen demand, mg/l	7.9	10.15	16.9	8.5	5.4	5.4	5.13	5.82	5.2	5.6	3.1	4.3	83.3	16.9	3.1
Total Khejdal nitrogen, mg/l	0.4	0.84	3.2	4.9	3.0	2.0	1.02	0.23	0.5	0.2	0.4	0.2	16.9	4.9	0.2
Total phosphorus, mg/l	0.0	ND	0.3	0.3	0.6	0.2	0.089	0.102	0.1	0.1	0.1	0.5	2.4	0.6	0.0
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	0.28	0.3	ND	0.3	0.3	1.2	0.3	0.3
Nitrate, mg/l	0.2	0.09	1.1	0.7	1.5	0.2	0.20	0.06	0.1	0.3	0.2	0.3	4.9	9.6	19.2
Chloride, mg/l	13.3	ND	10.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	24.0	13.3	10.8
Bromide, mg/l	ND	16.91	ND	9.2	9.5	3.3	3.67	10.29	11.3	6.6	16.6	6.3	93.7	16.9	3.3
Sulfate, mg/l	3.8	4.33	3.7	3.6	4.3	0.9	1.03	1.23	1.3	2.3	1.5	1.5	29.4	4.3	0.9

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments														
	Compost tea + Stabilized urea														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Total dissolved solids, mg/l	293.7	134.3	345.0	615.0	237.5	296.2	135.0	113.3	100.0	101.7	111.7	26.7	2510.1	615.0	26.7
Total suspended solids, mg/l	241.6	25.5	1138.3	6759.3	4234.1	1389.8	755.0	607.3	613.8	295.8	629.0	201.2	16890.4	6759.3	25.5
Turbidity, NTU	251.7	34.1	1831.5	6732.3	4007.5	1239.0	667.5	425.3	456.3	195.5	487.5	158.8	16486.7	6732.3	34.1
Biochemical oxygen demand, mg/l	9.0	8.5	22.9	8.1	7.1	5.5	3.8	5.4	6.1	7.1	2.4	4.5	90.1	22.9	2.4
Total Khejdal nitrogen, mg/l	0.2	1.7	1.3	4.5	5.6	1.0	0.8	2.1	0.9	0.2	0.2	0.4	19.0	5.6	0.2
Total phosphorus, mg/l	0.1	0.0	0.3	0.6	0.6	0.1	0.0	0.1	0.0	0.1	0.1	0.6	2.6	0.6	0.0
Nitrite, mg/l	0.7	ND	ND	ND	ND	ND	ND	0.3	0.3	ND	0.0	0.3	1.6	0.7	0.0
Nitrate, mg/l	10.0	0.1	0.7	1.5	8.0	1.0	2.5	0.4	0.2	0.2	0.2	0.3	25.2	10.0	0.1
Chloride, mg/l	13.2	ND	6.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	19.9	13.2	6.7
Bromide, mg/l	ND	12.8	ND	10.8	10.5	3.5	4.8	7.5	6.4	5.9	4.0	7.3	73.5	12.8	3.5
Sulfate, mg/l	3.2	3.2	3.4	3.7	3.2	1.3	1.4	1.1	1.2	2.1	1.1	2.1	27.0	3.7	1.1

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments														
	Shredded material														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Total dissolved solids, mg/l	162.2	190.3	236.4	520.0	201.2	132.5	122.5	170.0	51.7	73.3	80.0	0.0	1940.3	520.0	0.0
Total suspended solids, mg/l	104.3	22.2	1692.9	7707.8	5482.9	1923.8	1396.5	1631.7	1124.7	527.0	500.8	0.0	22114.5	7707.8	0.0
Turbidity, NTU	251.0	39.3	2144.0	6920.4	5123.1	1585.5	1339.0	1272.0	730.5	257.5	294.0	0.0	19956.3	6920.4	0.0
Biochemical oxygen demand, mg/l	5.6	13.6	15.3	9.3	9.6	5.5	4.1	5.6	5.5	7.0	3.3	0.0	84.4	15.3	0.0
Total Khejdal nitrogen, mg/l	0.7	2.2	4.1	5.8	4.7	1.6	0.7	1.0	0.7	0.3	0.4	0.0	22.1	5.8	0.0
Total phosphorus, mg/l	0.1	0.0	0.4	0.7	0.6	0.1	0.1	0.1	0.1	0.1	0.1	0.0	2.4	0.7	0.0
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	0.3	0.3	ND	0.4	0.0	0.9	0.4	0.0
Nitrate, mg/l	0.3	2.3	0.9	0.6	1.5	0.3	0.2	0.1	0.1	0.2	0.2	0.0	6.7	2.3	0.0
Chloride, mg/l	10.0	ND	12.9	ND	ND	ND	ND	ND	ND	ND	ND	0.0	22.9	12.9	0.0
Bromide, mg/l	ND	14.5	ND	11.2	10.5	3.4	3.7	12.8	9.1	4.8	17.6	0.0	87.6	17.6	0.0
Sulfate, mg/l	2.8	2.7	3.8	3.9	4.3	1.1	1.2	1.2	1.2	1.6	1.5	0.0	25.1	4.3	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments														
	Compost tea														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Total dissolved solids, mg/l	240.0	192.2	0.0	647.5	198.8	300.0	182.5	166.7	67.5	ND	192.2	41.7	233.8	647.5	0.0
Total suspended solids, mg/l	65.4	40.8	0.0	7149.8	2892.3	777.1	673.8	471.2	385.2	173.2	40.8	236.0	12905.5	7149.8	0.0
Turbidity, NTU	79.9	83.4	0.0	6444.4	2299.5	677.0	247.4	321.8	302.0	140.5	83.4	216.5	10895.8	6444.4	0.0
Biochemical oxygen demand, mg/l	11.9	7.3	0.0	9.9	6.9	4.8	5.7	5.3	4.8	5.9	7.3	4.3	74.1	11.9	0.0
Total Khejdal nitrogen, mg/l	0.3	0.9	0.0	10.7	1.7	1.0	0.5	0.2	1.4	0.6	0.9	4.9	23.1	10.7	0.0
Total phosphorus, mg/l	0.0	0.0	0.0	0.5	0.4	0.1	0.1	0.0	0.0	0.1	0.0	0.8	2.2	0.8	0.0
Nitrite, mg/l	ND	0.5	0.0	ND	ND	ND	ND	0.3	0.4	ND	0.5	0.2	1.9	0.5	0.0
Nitrate, mg/l	0.2	7.6	0.0	0.5	1.1	0.3	0.1	0.2	0.1	0.3	7.6	0.4	18.5	7.6	0.0
Chloride, mg/l	14.7	ND	0.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	14.7	14.7	0.0
Bromide, mg/l	ND	13.8	0.0	10.3	11.7	4.0	3.5	13.2	13.4	13.8	13.8	6.3	103.5	13.8	0.0
Sulfate, mg/l	2.4	2.8	0.0	3.3	4.8	1.3	1.8	1.7	1.7	2.7	2.8	1.6	26.8	4.8	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments														
	Full harvest retention														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Total dissolved solids, mg/l	202.0	125.2	303.7	695.0	223.8	121.2	137.5	185.8	105.0	90.0	74.2	0.0	2263.4	695.0	0.0
Total suspended solids, mg/l	82.1	14.7	853.3	6177.5	2652.5	457.8	548.0	349.7	487.3	193.9	360.5	0.0	12177.2	6177.5	0.0
Turbidity, NTU	192.5	21.6	1367.0	6545.0	2609.3	540.0	447.0	267.5	394.0	166.0	203.5	0.0	12753.3	6545.0	0.0
Biochemical oxygen demand, mg/l	7.3	8.9	13.0	10.0	4.5	4.8	5.1	5.2	5.1	7.1	2.9	0.0	73.6	13.0	0.0
Total Khejdal nitrogen, mg/l	0.3	1.3	3.9	8.8	2.5	1.0	1.3	1.9	1.3	0.2	0.3	0.0	22.9	8.8	0.0
Total phosphorus, mg/l	0.0	0.0	0.3	0.0	0.5	0.0	0.1	0.0	0.0	0.1	0.1	0.0	1.2	0.5	0.0
Nitrite, mg/l	ND	ND	ND	ND	ND	ND	ND	0.3	0.3	0.2	0.3	0.0	1.1	0.3	0.0
Nitrate, mg/l	0.3	0.2	1.2	0.6	1.2	0.3	0.2	0.1	0.1	0.3	0.2	0.0	4.5	1.2	0.0
Chloride, mg/l	10.7	ND	9.5	ND	ND	ND	ND	ND	ND	ND	ND	0.0	20.1	10.7	0.0
Bromide, mg/l	ND	11.1	ND	9.6	11.7	3.5	4.9	7.6	11.4	5.7	15.5	0.0	80.9	15.5	0.0
Sulfate, mg/l	2.9	3.0	3.8	3.7	4.6	1.3	1.4	1.3	1.5	2.0	1.5	0.0	27.0	4.6	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2006

Water Quality Parameters	Water Quality Parameter: Total dissolved solids, mg/l														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Ground Burning	232.0	193.2	267.5	607.5	191.3	220.0	160.0	283.3	116.7	86.7	80.0	33.3	2471.4	607.5	33.3
Compost Tea + Stabilized Urea	293.7	134.3	345.0	615.0	237.5	296.2	135.0	113.3	100.0	101.7	111.7	26.7	2510.1	615.0	26.7
Shredded Material	162.2	190.3	236.4	520.0	201.2	132.5	122.5	170.0	51.7	73.3	80.0	0.0	1940.3	520.0	0.0
Compost Tea	240.0	192.2	0.0	647.5	198.8	300.0	182.5	166.7	67.5	ND	192.2	41.7	2228.9	647.5	0.0
Full Harvest Retention	202.0	125.2	303.7	695.0	223.8	121.2	137.5	185.8	105.0	90.0	74.2	0.0	2263.4	695.0	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2006

Water Quality Parameters	Water Quality Parameter														
	Total suspended solids, mg/l														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Ground Burning	93.4	19.3	1544.5	7855.0	5036.0	2526.0	1230.5	1195.3	931.5	311.3	546.0	291.7	21580.4	7855.0	19.3
Compost Tea + Stabilized Urea	241.6	25.5	1138.3	6759.3	4234.1	1389.8	755.0	607.3	613.8	295.8	629.0	201.2	16890.4	6759.3	25.5
Shredded Material	104.3	22.2	1692.9	7707.8	5482.9	1923.8	1396.5	1631.7	1124.7	527.0	500.8	0.0	22114.5	7707.8	0.0
Compost Tea	65.4	40.8	0.0	7149.8	2892.3	777.1	673.8	471.2	385.2	173.2	40.8	236.0	12905.5	7149.8	0.0
Full Harvest Retention	82.1	14.7	853.3	6177.5	2652.5	457.8	548.0	349.7	487.3	193.9	360.5	0.0	12177.2	6177.5	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2006

Water Quality Parameters	Water Quality Parameter														
	Nitrate, mg/l														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Ground Burning	0.20	0.09	1.05	0.73	1.49	0.25	0.20	0.06	0.10	0.32	0.15	0.30	4.9	1.5	0.1
Compost Tea + Stabilized Urea	9.95	0.12	0.69	1.46	8.02	1.05	2.54	0.41	0.15	0.24	0.19	0.34	25.2	10.0	0.1
Shredded Material	0.28	2.30	0.88	0.62	1.47	0.31	0.18	0.14	0.10	0.22	0.20	0.00	6.7	2.3	0.0
Compost Tea	0.18	7.63	0.00	0.53	1.08	0.31	0.15	0.22	0.14	0.29	7.63	0.36	18.5	7.6	0.0
Full Harvest Retention	0.25	0.16	1.17	0.63	1.16	0.30	0.19	0.09	0.12	0.26	0.20	0.00	4.5	1.2	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2006

Water Quality Parameters	Water Quality Parameter														
	Total phosphorus, mg/l														
	2/14/2006	2/27/2006	4/27/2006	5/1/2006	5/8/2006	7/10/2006	7/11/2006	7/17/2006	7/24/2006	8/17/2006	8/28/2006	9/25/2006	Total	Maximum	Minimum
Ground Burning	0.05	ND	0.35	0.30	0.60	0.18	0.09	0.10	0.07	0.10	0.06	0.52	2.4	0.6	0.0
Compost Tea + Stabilized Urea	0.12	0.02	0.26	0.62	0.55	0.07	0.04	0.07	0.04	0.11	0.09	0.60	2.6	0.6	0.0
Shredded Material	0.09	0.01	0.37	0.69	0.59	0.11	0.10	0.14	0.07	0.09	0.10	0.00	2.4	0.7	0.0
Compost Tea	0.04	0.03	0.00	0.55	0.43	0.08	0.06	0.04	0.04	0.11	0.03	0.79	2.2	0.8	0.0
Full Harvest Retention	0.03	0.01	0.28	0.04	0.50	0.03	0.07	0.03	0.04	0.12	0.11	0.00	1.2	0.5	0.0

APPENDIX B

SAMPLE-DATA 2007

This appendix contains the data for samples collected during 2007. Water quality parameters are indicated for each treatment and averages were calculated based on two replications when available. A summary for each treatment is also shown in this section.

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Sampling date: 1/22/2007

Water Quality Parameters	Treatments														
	Ground burning			Stabilized urea+ Compost tea			Shredded material			Compost tea			Full harvest retention		
	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Avg
Total dissolved solids, mg/l							806.7		806.7				815.0		815.0
Total suspended solids, mg/l							238.0		238.0				315.0		315.0
Turbidity, NTU							501		501.0				586		586.0
Biochemical oxygen demand, mg/l							2.02		2.0				2.26		2.3
Total Khejdal nitrogen, mg/l							0.37		0.4				0.25		0.3
Total phosphorus, mg/l							0.481		0.5				0.413		0.4
Nitrite, mg/l							0.315		0.3				0.31		0.3
Nitrate, mg/l							0.147		0.1				0.053		0.1
Chloride, mg/l							ND		ND				ND		ND
Bromide, mg/l							2.635		2.6				2.655		2.7
Sulfate, mg/l							0.48		0.5				1.16		1.2

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Sampling date: 1/29/2007

Water Quality Parameters	Treatments																
	Ground burning			Stabilized urea+ Compost tea			Shredded material				Compost tea				Full harvest retention		
	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Avg
Total dissolved solids, mg/l				537.0		537.0	502.0	474.0	19.8	488.0	499.0	436.0	44.5	467.5	322.0		322.0
Total suspended solids, mg/l				121.1		121.1	249.1	138.7	78.1	193.9	64.4	68.8	3.1	66.6	100.2		100.2
Turbidity, NTU				231		231.0	375	232	101.1	303.5	112	65.7	32.7	88.9	138.5		138.5
Biochemical oxygen demand, mg/l				2.965		3.0	1.785	2.69	0.6	2.2	3.43	3.2975	0.1	3.4	2.8675		2.9
Total Khejdal nitrogen, mg/l				0.18		0.2	0.15	0.12	0.0	0.1	0.12	0.12	0.0	0.1	0.13		0.1
Total phosphorus, mg/l				0.363		0.4	0.503	0.376	0.1	0.4	0.269	0.433	0.1	0.4	0.309		0.3
Nitrite, mg/l				0.2855		ND	0.3177	0.2511	0.0	ND	0.2432	0.3562	0.1	0.3	0.2001		0.2
Nitrate, mg/l				0.0364		0.0	0.014	0.0146	0.0	0.0	0.0231	0.0255	0.0	0.0	0.0135		0.0
Chloride, mg/l				ND		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND
Bromide, mg/l				1.9148		1.9	1.7751	1.7708	0.0	1.8	1.9811	1.7075	0.2	1.8	1.7896		1.8
Sulfate, mg/l				0.40		0.4	0.44	0.34	0.1	0.4	0.57	0.67	0.1	0.6	0.70		0.7

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 2/13/2007

Water Quality Parameters	Treatments																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	423.3	280.0	101.4	351.7	913.3	243.3	473.8	578.3	878.3	376.7	354.7	627.5	220.0	230.0	7.1	225.0	518.3	218.3	212.1	368.3
Total suspended solids, mg/l	2747.5	4392.0	1162.8	3569.8	2772.7	576.0	1553.3	1674.3	2548.3	3158.3	431.3	2853.3	454.8	452.0	2.0	453.4	2476.0	529.2	1376.6	1502.6
Turbidity, NTU	2335	3951	1142.7	3143.0	2670	388	1613.6	1529.0	2383	2651	189.5	2517.0	338	405	47.4	371.5	2786	428.0	1667.4	1607.0
Biochemical oxygen demand, mg/l	8.235	7.995	0.2	8.1	12.17	7.32	3.4	9.7	7.065	7.59	0.4	7.3	10.8	9.93	0.6	10.4	7.71	2.39	3.8	5.0
Total Khejdal nitrogen, mg/l	0.54	0.81	0.2	0.7	0.31	0.31	0.0	0.3	0.42	0.63	0.1	0.5	0.55	0.04	0.4	0.3	0.40	0.23	0.1	0.3
Total phosphorus, mg/l	0.952	1.496	0.4	1.2	0.874	0.369	0.4	0.6	0.894	0.818	0.1	0.9	0.444	0.439	0.0	0.4	0.789	0.464	0.2	0.6
Nitrite, mg/l	0.135	0.17	0.0	ND	0.141	0.199	0.0	ND	0.128	0.169	0.0	ND	0.213	0.107	0.1	0.2	0.193	0.11	0.1	0.2
Nitrate, mg/l	0.041	0.066	0.0	0.1	0.073	0.093	0.0	0.1	0.073	0.07	0.0	0.1	0.067	0.07	0.0	0.1	0.079	0.05	0.0	0.1
Chloride, mg/l	ND	ND	ND	ND	ND	0.201	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	4.111	3.534	0.4	3.8	3.744	2.989	0.5	3.4	3.634	3.567	0.0	3.6	2.537	2.572	0.0	2.6	3.905	2.50	1.0	3.2
Sulfate, mg/l	1.19	1.05	0.1	1.1	0.79	1.28	0.3	1.0	1.05	1.15	0.1	1.1	1.39	0.16	0.9	0.8	1.28	1.71	0.3	1.5

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 3/15/2007

Water Quality Parameters	Treatments																
	Ground burning			Stabilized urea+ Compost tea			Shredded material			Compost tea				Full harvest retention			
	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	133.3		133.3				113.3		113.33	108.3	156.7	34.2	132.5	141.7	105.0	25.9	123.3
Total suspended solids, mg/l	268.2		268.2				144.0		144.0	3048.3	110.0	2077.7	1579.2	190.2	90.5	70.5	140.3
Turbidity, NTU	234		234.0				139		139.0	80.1	178	69.2	129.1	221	109.0	79.2	165.0
Biochemical oxygen demand, mg/l	4.125		4.1				4.545		4.5	5.55	5.145	0.3	5.3	5.655	4.65	0.7	5.2
Total Khejdal nitrogen, mg/l	0.24		0.2				ND		ND	2.15	0.48	1.2	1.3	1.10	ND	ND	1.1
Total phosphorus, mg/l	0.243		0.2				0.131		0.1	0.259	0.196	0.0	0.2	0.142	0.114	0.0	0.1
Nitrite, mg/l	0.319		ND				0.349		0.3	0.321	0.421	0.1	0.4	0.224	0.30	0.1	0.3
Nitrate, mg/l	0.08		0.1				0.033		0.03	0.035	0.021	0.0	0.0	0.021	0.10	0.1	0.1
Chloride, mg/l	ND		ND				ND		ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	1.126		1.1				1.029		1.0	1.375	1.41	0.0	1.4	1.284	1.19	0.1	1.2
Sulfate, mg/l	2.11		2.1				1.11		1.1	1.53	1.15	0.3	1.3	1.08	1.93	0.6	1.5

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 4/11/2007

Water Quality Parameters	Treatments															
	Ground burning			Stabilized urea+ Compost tea			Shredded material				Compost tea			Full harvest retention		
	R-I	R-II	Avg	R-I	R-II	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	1053.3		1053.3	1013.3		1013.3	1038.3	863.3	123.7	950.8	1036.7		1036.7	1033.3	776.7	181.5	905.0
Total suspended solids, mg/l	878.0		878.0	221.0		221.0	649.5	920.7	191.7	785.1	843.3		843.3	581.7	808.0	160.0	694.8
Turbidity, NTU	1029		1029.0	307		307.0	685	1193	359.2	939.0	1049.5		1049.5	577	583.0	4.2	580.0
Biochemical oxygen demand, mg/l	3.93		3.9	7.71		7.7	4.5	4.14	0.3	4.3	4.515		4.5	5.82	6.15	0.2	6.0
Total Khejdal nitrogen, mg/l	2.23		2.2	0.92		0.9	1.30	1.96	0.5	1.6	2.00		2.0	NS	NS	ND	NS
Total phosphorus, mg/l	1.748		1.7	0.947		0.9	1.139	NS	ND	1.1	1.583		1.6	NS	NS	ND	NS
Nitrite, mg/l	0.307		0.3	0.234		0.2	0.3722	0.2372	0.1	0.3	0.2617		0.3	0.1517	0.15	0.0	0.1
Nitrate, mg/l	2.135		2.1	5.1587		5.2	2.6911	1.8713	0.6	2.3	2.0879		2.1	1.7315	0.71	0.7	1.2
Chloride, mg/l	0.574		0.6	0.7765		0.8	0.0795	0.736	0.5	0.4	0.1249		0.1	0.0815	0.09	0.0	0.1
Bromide, mg/l	8.99		9.0	13.3935		13.4	13.8039	9.3505	3.1	11.6	11.9951		12.0	11.2048	5.50	4.0	8.4
Sulfate, mg/l	6.78		6.8	6.34		6.3	7.83	5.21	1.9	6.5	6.24		6.2	5.87	3.69	1.5	4.8

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Sampling date: 4/26/2007

Water Quality Parameters	Treatments																			
	Ground burning				Stabilized urea+ Compost tea				Shredded material				Compost tea				Full harvest retention			
	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg	R-I	R-II	Stdev	Avg
Total dissolved solids, mg/l	910.0	1130.0	155.6	1020.0	1033.3	1425.0	277.0	1229.2	1023.3	981.7	29.5	1002.5	925.0	1050.0	88.4	987.5	936.7	1201.7	187.4	1069.2
Total suspended solids, mg/l	7995.0	5982.3	1423.2	6988.7	2457.7	9326.0	4856.6	5891.8	8456.7	6810.3	1164.1	7633.5	6169.8	4840.0	940.3	5504.9	4308.8	8879.2	3231.7	6594.0
Turbidity, NTU	6370	4908	1034.1	5638.8	2415	5670	2301.6	4042.5	7000	8640	1159.7	7820.0	6223	4845	974.0	5533.8	3840	4940.0	777.8	4390.0
Biochemical oxygen demand, mg/l	4.62	5.55	0.7	5.1	7.44	5.67	1.3	6.6	6.195	6.06	0.1	6.1	4.86	3.795	0.8	4.3	3.81	5.76	1.4	4.8
Total Khejdal nitrogen, mg/l	0.46	0.44	0.0	0.5	0.76	0.26	0.4	0.5	0.80	0.26	0.4	0.5	0.74	0.53	0.1	0.6	0.72	0.24	0.3	0.5
Total phosphorus, mg/l	7.628	6.239	1.0	6.9	5.250	5.967	0.5	5.6	7.910	4.996	2.1	6.5	5.697	5.643	0.0	5.7	4.954	6.995	1.4	6.0
Nitrite, mg/l	0.415	0.338	0.1	ND	0.4828	0.384	0.1	ND	0.445	0.29	0.1	0.4	0.286	0.364	0.1	0.3	0.289	0.35	0.0	0.3
Nitrate, mg/l	0.298	0.35	0.0	0.3	2.2814	0.4034	1.3	1.3	0.322	0.264	0.0	0.3	0.341	0.326	0.0	0.3	0.695	0.22	0.3	0.5
Chloride, mg/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromide, mg/l	5.655	11.8	4.3	8.7	26.6912	5.1725	15.2	15.9	16.02	5.166	7.7	10.6	6.171	7.786	1.1	7.0	14.18	4.62	6.8	9.4
Sulfate, mg/l	1.74	2.52	0.5	2.1	4.06	1.69	1.7	2.9	2.73	1.69	0.7	2.2	2.18	2.47	0.2	2.3	3.72	1.80	1.4	2.8

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments								
	Ground Burning								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Total dissolved solids, mg/l	0.0	0.0	351.7	133.3	1053.3	1020.0	2558.3	1053.3	0.0
Total suspended solids, mg/l	0.0	0.0	3569.8	268.2	878.0	6988.7	11704.6	6988.7	0.0
Turbidity, NTU	0.0	0.0	3143.0	234.0	1029.0	5638.8	10044.8	5638.8	0.0
Biochemical oxygen demand, mg/l	0.0	0.00	8.1	4.1	3.9	5.1	21.3	8.1	0.0
Total Khejdal nitrogen, mg/l	0.0	0.00	0.7	0.2	2.2	0.5	3.6	2.2	0.0
Total phosphorus, mg/l	0.0	0.000	1.2	0.2	1.7	6.9	10.1	6.9	0.0
Nitrite, mg/l	0.0	0.00	ND	ND	0.3	ND	0.3	0.3	0.0
Nitrate, mg/l	0.0	0.00	0.1	0.1	2.1	0.3	2.6	5.2	10.4
Chloride, mg/l	0.0	0.00	ND	ND	0.6	ND	0.6	0.6	0.0
Bromide, mg/l	0.0	0.00	3.8	1.1	9.0	8.7	22.7	9.0	0.0
Sulfate, mg/l	0.0	0.00	1.1	2.1	6.8	2.1	12.1	6.8	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments								
	Compost Tea + Stabilized Urea								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Total dissolved solids, mg/l	0.0	537.0	578.3	0.0	1013.3	1229.2	3357.8	1229.2	0.0
Total suspended solids, mg/l	0.0	121.1	1674.3	0.0	221.0	5891.8	7908.3	5891.8	0.0
Turbidity, NTU	0.0	231.0	1529.0	0.0	307.0	4042.5	6109.5	4042.5	0.0
Biochemical oxygen demand, mg/l	0.0	2.97	9.7	0.0	7.7	6.6	27.0	9.7	0.0
Total Khejdal nitrogen, mg/l	0.0	0.18	0.3	0.0	0.9	0.5	1.9	0.9	0.0
Total phosphorus, mg/l	0.0	0.363	0.6	0.0	0.9	5.6	7.5	5.6	0.0
Nitrite, mg/l	0.0	ND	ND	0.0	0.2	ND	0.2	0.2	0.0
Nitrate, mg/l	0.0	0.04	0.1	0.0	5.2	1.3	6.6	13.2	26.4
Chloride, mg/l	0.0	ND	ND	0.0	0.8	ND	0.8	0.8	0.0
Bromide, mg/l	0.0	1.91	3.4	0.0	13.4	15.9	34.6	15.9	0.0
Sulfate, mg/l	0.0	0.40	1.0	0.0	6.3	2.9	10.7	6.3	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments								
	Shredded Material								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Total dissolved solids, mg/l	806.7	488.0	627.5	113.3	950.8	1002.5	3988.8	1002.5	113.3
Total suspended solids, mg/l	238.0	193.9	2853.3	144.0	785.1	7633.5	11847.8	7633.5	144.0
Turbidity, NTU	501.0	303.5	2517.0	139.0	939.0	7820.0	12219.5	7820.0	139.0
Biochemical oxygen demand, mg/l	2.0	2.24	7.3	4.5	4.3	6.1	26.6	7.3	2.0
Total Khejdal nitrogen, mg/l	0.4	0.14	0.5	ND	1.6	0.5	3.2	1.6	0.1
Total phosphorus, mg/l	0.5	0.440	0.9	0.1	1.1	6.5	9.5	6.5	0.1
Nitrite, mg/l	0.3	ND	ND	0.3	0.3	0.4	1.3	0.4	0.3
Nitrate, mg/l	0.1	0.01	0.1	0.0	2.3	0.3	2.8	5.5	11.1
Chloride, mg/l	ND	ND	ND	ND	0.4	ND	0.4	0.4	0.4
Bromide, mg/l	2.6	1.77	3.6	1.0	11.6	10.6	31.2	11.6	1.0
Sulfate, mg/l	0.5	0.39	1.1	1.1	6.5	2.2	11.8	6.5	0.4

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments								
	Compost Tea								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Total dissolved solids, mg/l	0.0	467.5	225.0	132.5	1036.7	987.5	2849.2	1036.7	0.0
Total suspended solids, mg/l	0.0	66.6	453.4	1579.2	843.3	5504.9	8447.4	5504.9	0.0
Turbidity, NTU	0.0	88.9	371.5	129.1	1049.5	5533.8	7172.7	5533.8	0.0
Biochemical oxygen demand, mg/l	0.0	3.36	10.4	5.3	4.5	4.3	27.9	10.4	0.0
Total Khejdal nitrogen, mg/l	0.0	0.12	0.3	1.3	2.0	0.6	4.4	2.0	0.0
Total phosphorus, mg/l	0.0	0.351	0.4	0.2	1.6	5.7	8.3	5.7	0.0
Nitrite, mg/l	0.0	0.30	0.2	0.4	0.3	0.3	1.4	0.4	0.0
Nitrate, mg/l	0.0	0.02	0.1	0.0	2.1	0.3	2.5	5.1	10.1
Chloride, mg/l	0.0	ND	ND	ND	0.1	ND	0.1	0.1	0.0
Bromide, mg/l	0.0	1.84	2.6	1.4	12.0	7.0	24.8	12.0	0.0
Sulfate, mg/l	0.0	0.62	0.8	1.3	6.2	2.3	11.3	6.2	0.0

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana

Water Quality Parameters	Treatments								
	Full Harvest Retention								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Total dissolved solids, mg/l	815.0	322.0	368.3	123.3	905.0	1069.2	3602.8	1069.2	123.3
Total suspended solids, mg/l	315.0	100.2	1502.6	140.3	694.8	6594.0	9347.0	6594.0	100.2
Turbidity, NTU	586.0	138.5	1607.0	165.0	580.0	4390.0	7466.5	4390.0	138.5
Biochemical oxygen demand, mg/l	2.3	2.87	5.0	5.2	6.0	4.8	26.1	6.0	2.3
Total Khejdal nitrogen, mg/l	0.3	0.13	0.3	1.1	NS	0.5	2.3	1.1	0.1
Total phosphorus, mg/l	0.4	0.309	0.6	0.1	NS	6.0	7.5	6.0	0.1
Nitrite, mg/l	0.3	0.20	0.2	0.3	0.1	0.3	1.4	0.3	0.1
Nitrate, mg/l	0.1	0.01	0.1	0.1	1.2	0.5	1.9	3.7	7.4
Chloride, mg/l	ND	ND	ND	ND	0.1	ND	0.1	0.1	0.1
Bromide, mg/l	2.7	1.79	3.2	1.2	8.4	9.4	26.6	9.4	1.2
Sulfate, mg/l	1.2	0.70	1.5	1.5	4.8	2.8	12.4	4.8	0.7

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2007

Water Quality Parameters	Water Quality Parameter								
	Total dissolved solids, mg/l								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Ground Burning	0.0	0.0	351.7	133.3	1053.3	1020.0	2558.3	1053.3	0.0
Compost Tea + Stabilized Urea	0.0	537.0	578.3	0.0	1013.3	1229.2	3357.8	1229.2	0.0
Shredded Material	806.7	488.0	627.5	113.3	950.8	1002.5	3988.8	1002.5	113.3
Compost Tea	0.0	467.5	225.0	132.5	1036.7	987.5	2849.2	1036.7	0.0
Full Harvest Retention	815.0	322.0	368.3	123.3	905.0	1069.2	3602.8	1069.2	123.3

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2007

Water Quality Parameters	Water Quality Parameter: Total suspended solids, mg/l								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Ground Burning	0.0	0.0	3569.8	268.2	878.0	6988.7	11704.6	6988.7	0.0
Compost Tea + Stabilized Urea	0.0	121.1	1674.3	0.0	221.0	5891.8	7908.3	5891.8	0.0
Shredded Material	238.0	193.9	2853.3	144.0	785.1	7633.5	11847.8	7633.5	144.0
Compost Tea	0.0	66.6	453.4	1579.2	843.3	5504.9	8447.4	5504.9	0.0
Full Harvest Retention	315.0	100.2	1502.6	140.3	694.8	6594.0	9347.0	6594.0	100.2

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2007

Water Quality Parameters	Water Quality Parameter								
	Nitrate, mg/l								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Ground Burning	0.00	0.00	0.05	0.08	2.13	0.32	2.6	2.1	0.0
Compost Tea + Stabilized Urea	0.00	0.04	0.08	0.00	5.16	1.34	6.6	5.2	0.0
Shredded Material	0.15	0.01	0.07	0.03	2.28	0.29	2.8	2.3	0.0
Compost Tea	0.00	0.30	0.16	0.37	0.26	0.33	1.4	0.4	0.0
Full Harvest Retention	0.31	0.20	0.15	0.26	0.15	0.32	1.4	0.3	0.1

DEGRADATION AND WATER QUALITY DYNAMICS OF SUGARCANE RESIDUE IN SOUTH LOUISIANA

Location: Youngsville, Louisiana
Year: 2007

Water Quality Parameters	Water Quality Parameter								
	Total phosphorus, mg/l								
	1/22/2007	1/29/2007	2/13/2007	3/15/2007	4/11/2007	4/26/2007	Total	Maximum	Minimum
Ground Burning	0.00	0.00	1.22	0.24	1.75	6.93	10.1	6.9	0.0
Compost Tea + Stabilized Urea	0.00	0.36	0.62	0.00	0.95	5.61	7.5	5.6	0.0
Shredded Material	0.48	0.44	0.86	0.13	1.14	6.45	9.5	6.5	0.1
Compost Tea	0.00	0.35	0.44	0.23	1.58	5.67	8.3	5.7	0.0
Full Harvest Retention	0.41	0.31	0.63	0.13	NS	5.97	7.5	6.0	0.1

APPENDIX C

ST. GABRIEL 2006-2007 CARBON DIOXIDE FLUX-DATA

This appendix contains the data collected in St. Gabriel Research Station during 2006-2007 experimental periods. Descriptive statistics are displayed for Soil carbon flux (μmol m^2 s^{-1}).

Location: St. Gabriel, Louisiana

Treatments		Soil Carbon Dioxide Flux, µmol m^2 s^{-1}							
		2006				2007			
Dosage, m^3 ha^{-1}	**Applications**	Average	Maximum	Minimum	Stdev	Average	Maximum	Minimum	Stdev
0	1	0.95	0.97	0.91	0.030	2.44	3.69	1.81	1.085
	2	1.01	1.08	0.95	0.067	2.31	2.40	2.22	0.090
	3	0.51	0.57	0.47	0.049	2.72	3.31	1.56	1.002
2.8	***1***	1.23	2.1	0.6	0.802	1.28	1.68	1.28	0.225
	2	0.97	1.2	0.6	0.283	2.34	3.56	2.39	0.585
	3	1.41	1.9	0.8	0.574	3.43	3.83	2.60	0.643
5.6	1	1.07	1.3	0.8	0.239	2.62	3.86	1.65	1.129
	2	1.18	1.6	0.9	0.362	3.08	4.74	1.56	1.594
	3	1.01	1.3	0.6	0.348	2.61	2.85	2.43	0.216
11.4	1	0.83	1.4	0.4	0.503	2.39	2.7	1.9	0.462
	2	1.24	1.5	0.8	0.366	2.98	3.7	2.0	0.883
	3	0.83	1.2	0.4	0.388	3.14	3.72	2.27	0.769

APPENDIX D

ST. GABRIEL PLANNING MAP

Appendix D displays the planning map for the experimental design conducted in St. Gabriel Research Station, Louisiana. A Split Plot Design with three replications was arranged on a Complete Randomized Block Design. Compost tea concentrations were applied to “Big” plots and Frequencies to “Small” plots. Soil carbon dioxide flux ($\mu mol\ m^{2}\ s^{-1}$) was measured as well as temperature (^{o}C).

PLANNING MAP
DEGRADATION KINETICS OF SUGARCANE RESIDUE IN-SITU (ST GABRIEL).

Conventional Treatment

37	38	39	40	41	42	43	44	45	46	47	48
0	0	0	1160-2	1160-1	1160-3	580-2	580-3	580-1	290-3	290-1	290-2

49	50	51	52	53	54	55	56	57	58	59	60
0-2	290-3	290-1	1160-1	1160-2	1160-3	580-2	580-3	580-1	0	0	0

61	62	63	64	65	66	67	68	69	70	71	72
	0	0	580-2	580-3	580-1	290-3	290-2	290-1	1160-1	1160-3	1160-2

Treatments:

Method:	Concentrations:	Application Times:
Conventional	0x: 0 ml/m^2	1 Application
	0.5x: 290 ml/m^2	2 Applications
	1 x: 580 ml/m^2	3 Applications
	2 x: 1290 ml/m^2	

APPENDIX E

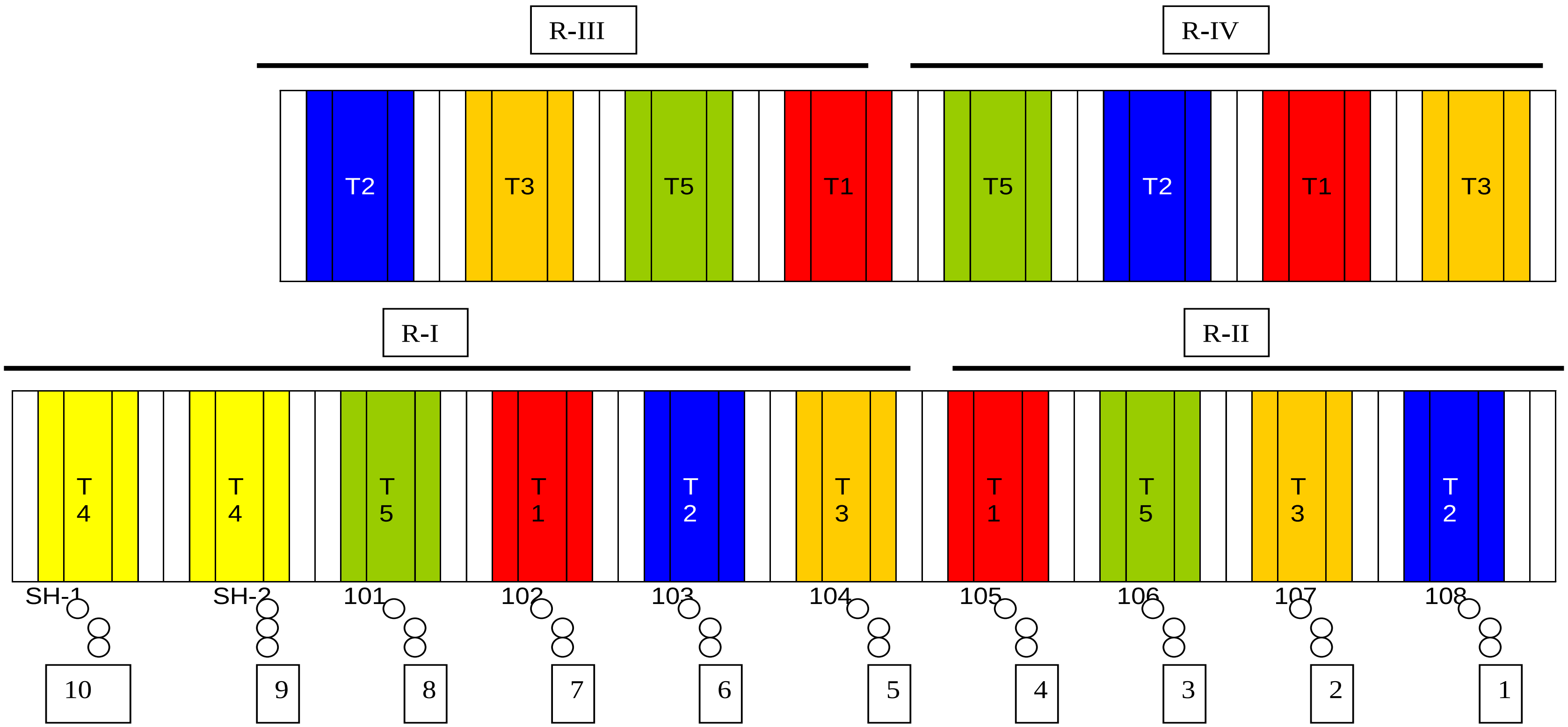
YOUNGSVILLE PLANNING MAP

Appendix E displays the planning map for the experimental design conducted in Youngsville, Louisiana. A Complete Randomized Block Design with four replications was installed. Water quality parameters were measured on two replications. Runoff water samplers devices were located at the end of the experimental units.

PLANNING MAP- YOUNGSVILLE
WATER QUALITY FROM SUGAR CANE BASED ON RESIDUE MANAGEMENT.

Treatments:
T1: Ground burning of trash mat
T2: Compost tea+ Stabilized Urea
T3: Shredded Material
T4: Compost Tea
T5: Full post-harvest retention of trash mat

* Five cane rows /treatment
* Circles (3) / treatments = collection barrels
* Experiment Unit Size = 30’ x100’
* Useful Unit Size = 12’ x 100’



VITA

Jose was born in El Salvador in a small town called “Texistepeque” (Nahuat name); He received his bachelor of science from University of El Salvador in 1989 in agricultural engineering; after that, he started to work as a junior researcher in the Center for Agricultural Technology in El Salvador. In 1996, he went back to school at New Mexico State University where he graduated from the Civil and Agricultural Engineering Department with a Master of Science in water resources. After five years, the opportunity to go back to school was presented. In 2004 he started his doctoral program in Louisiana State University where he was admitted in the Engineering Science Program. Jose is expecting to graduate during the spring session of 2008, with the degree of Doctor of Philosophy.